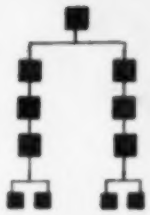
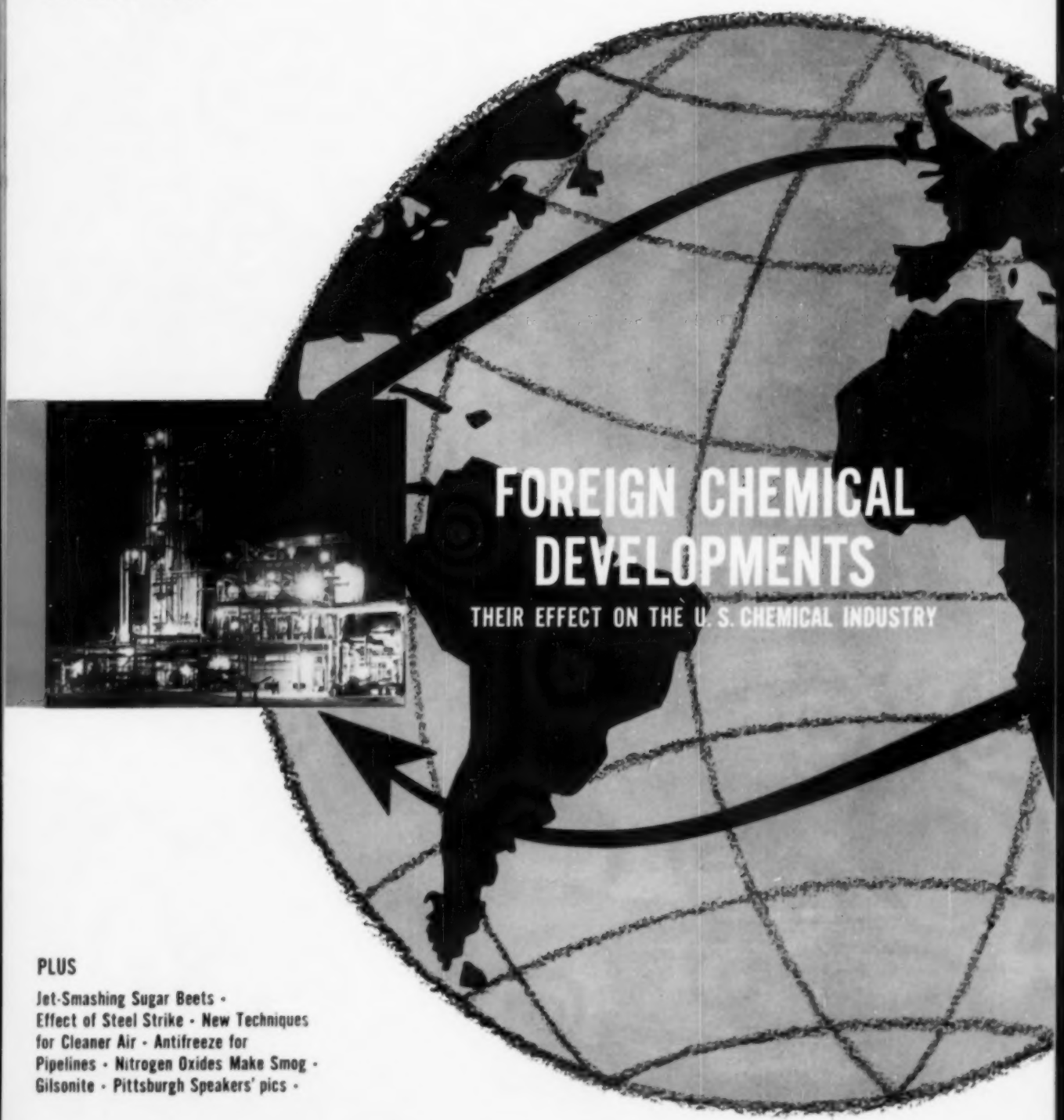
# Chemical Engineering Progress

IMPROVE YOUR PILOT PLANT OPERATION



AUGUST 1956



## FOREIGN CHEMICAL DEVELOPMENTS

THEIR EFFECT ON THE U. S. CHEMICAL INDUSTRY



**PLUS**

Jet-Smashing Sugar Beets · Effect of Steel Strike · New Techniques for Cleaner Air · Antifreeze for Pipelines · Nitrogen Oxides Make Smog · Gilsonite · Pittsburgh Speakers' pics ·

# PROVEN

## BY PERFORMANCE

# INVENTA-VULCAN

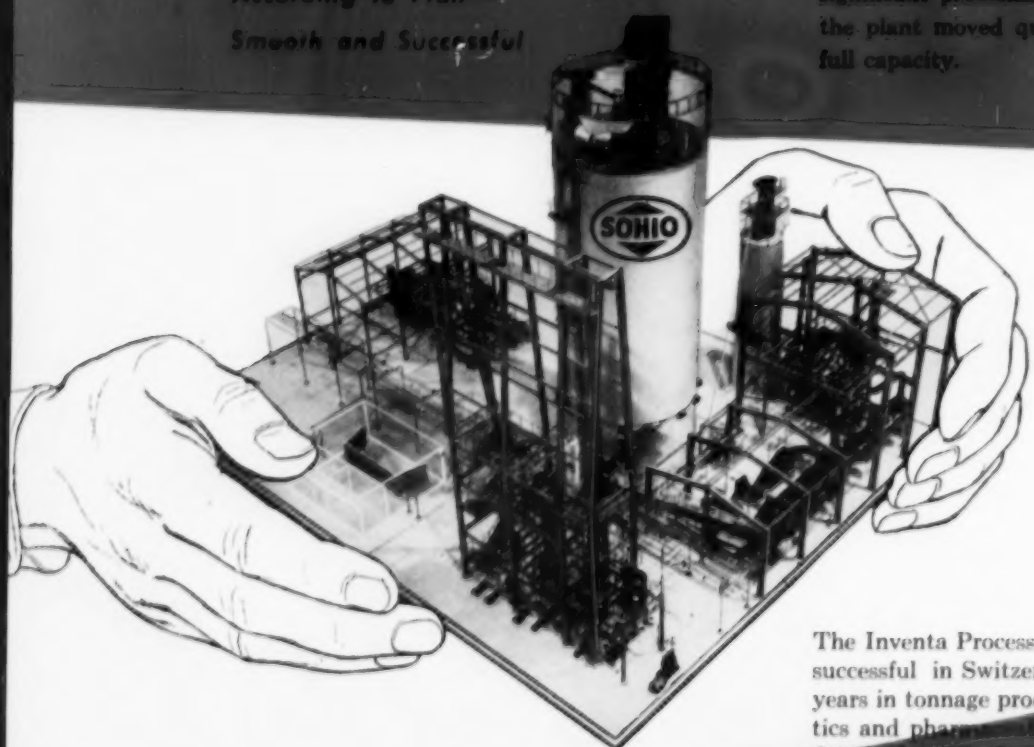
## UREA PROCESS

*Sohio Startup*
*According to Plan—*
*Smooth and Successful*

The first Inventa-Vulcan urea plant in the United States is now on stream. This new plant was designed and built by Vulcan Engineering Division—licensors of the Inventa Process in the U. S. and Canada—for Sohio's $17,000,000 petrochemicals installation at Lima, Ohio.

Within six hours after startup high quality urea was produced. Ease and reliability of operation were demonstrated. Startup produced first urea solutions and then prills for agricultural purposes exactly as planned.

Corrosion, traditionally present in urea synthesis, was conspicuously absent, as were clogged lines and contaminated product. No significant problems were encountered and the plant moved quickly and smoothly to full capacity.




VULCAN

The Inventa Process has been commercially successful in Switzerland for more than six years in tonnage production of urea of plastics and pharmaceutical grades. Additional details about the Inventa-Vulcan Urea Process may be had by writing to the Vulcan Engineering Division.

# VULCAN ENGINEERING DIVISION

Vulcan-Cincinnati, Inc., General Offices and Plant, CINCINNATI 2, OHIO
BOSTON CHARLOTTE N. C. DENVER HOUSTON SAN FRANCISCO
VICKERS VULCAN PROCESS ENGINEERING CO., LTD., MONTREAL, CANADA

DIVISIONS OF VULCAN CINCINNATI, INC.
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Chemical Engineering Progress

# what's in this issue

August, 1956 • Volume 52, No. 8



***(Continued on page 5)*** ⟶

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•

Cover design by
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# what's in this issue

*(Continued from page 3)*

## Noted and quoted

**Wanted:**

A man for hard work and rapid promotion;
A man who can find work to do without the help of a manager and three assistants;
A man who gets to work on time in the morning and doesn't imperil the lives of others in an effort to be first out of the office at night;
A man who is neat in appearance;
A man who doesn't sulk for an hour about overtime in emergencies;
A man who listens carefully when spoken to and asks only enough questions to insure the accurate carrying out of instructions;
A man who looks you straight in the face and tells the truth every time;
A man who moves quickly and makes as little noise as possible about it;
A man who doesn't pity himself for having to work.
Apply anywhere—the world is searching for such men.

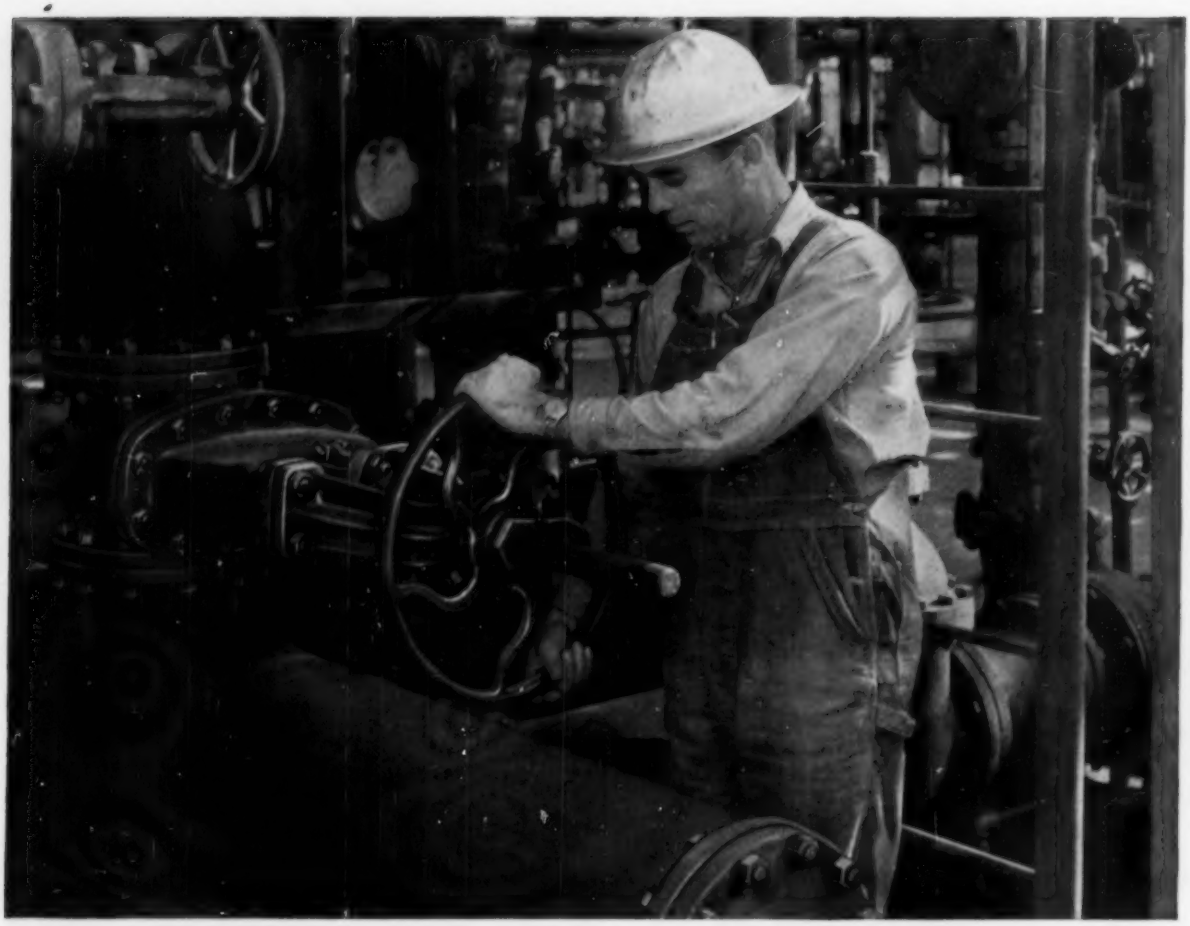
*Anon*

**Industrial Symphony**

Naturally, in seeking reasons for growth it is a temptation to emphasize the big, dramatic things—a new favorably situated plant, or development of a new especially successful product. But growth *begins* with much less striking things—with the day by day decisions that result in quality products, which are efficiently produced and fairly priced. To achieve these ends, management is somewhat in the position of a conductor who leads a large, enormously complicated symphony. Among the instruments in the industrial orchestra are sales, engineering and production; research, accounting and purchasing; general development, legal work and patent work; and industrial relations, financial relations, and public relations. These, and many more must be meshed into one harmonious whole—although they often seem to play conflicting tunes.

For example, production's principal function is making—at the right time—enough tons of the right products of the proper quality at the lowest possible cost. Industrial relations' end function is to assure high productivity per worker and low labor turnover, which depend in large part upon good pay, steady employment and good working conditions. Yet if the pay and working conditions become extravagant the pro-

(*Continued on page* 14)



## No leakage, no sticking with this Crane valve after 2 years on heavy alkylate at 300° F.

THE CASE HISTORY—How do Crane cast steel gate valves hold up on heavy alkylate? The No. 47X 10-inch, 150-pound valve you see above has been in service at Eastern States Petroleum Co. refinery at Houston for over two years.

It handles re-run bottoms from the $H_2SO_4$ alkylation unit at 300° F. In addition to erosion from solid carbon, there is mild corrosion present from acid. Valve operation is on an average of once every 1½ weeks.

Not once has Eastern States had to put a wrench on this Crane valve. There has been no leakage, no sticking whatsoever. Closure is tight and sure, and response to the handwheel is as smooth and easy as the day the valve was installed.

Unusual performance? Not for Crane cast steel gate valves. For these valves differ from other valves on the *inside*—where performance stands or falls.

Over a century of skill is back of their sound design and pressure-tight castings, and in the heat treating and finishing of the Crane Exelloy seating. That's why Crane valves are *preferred* for refinery service.

Whatever you need in refinery valves—gates, globes, angles and checks—screwed, flanged or welding ends—sizes up to 24 in.—in pressure classes up to 2500 psi.—check with Crane first.

Call your local Crane Representative for valuable help in specifying and ordering, or write to address below.

**CRANE VALVES & FITTINGS**

**PIPE • KITCHENS • PLUMBING • HEATING**

*Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas*

# $NH_3$

# 3 more ammonia plants by Foster Wheeler

**Three major petrochemical manufacturing companies have recently authorized Foster Wheeler to proceed with the design and construction of three Ammonia Synthesis Plants having a combined $NH_3$ production capacity of 585 tons/day. One of these plants will have a design capacity of 305 tons/day, the largest ever built by Foster Wheeler.**

**Hydrogen, for all three plants, will be separated from hydrogen-rich tail gas streams from nearby processing units.**

**These contracts reflect industry's approval of the Casale Process for Ammonia Synthesis and also Foster Wheeler's design, engineering and construction "know how". When these plants are completed, Foster Wheeler will have built —**

**9** $NH_3$ Synthesis plants with a combined capacity of **1585 T/D**

**FOSTER WHEELER**

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

## Noted and quoted

(*Continued from page* 10)

duction department would be hard put to produce chemicals that could be competitively priced. Nor could we, under such circumstances, support an aggressive research team, or supply engineering with the proper materials and equipment, or keep our stockholders happy.

Every department, then, must be kept in proper balance: in engineering there must be efficient designs and durable construction at reasonable capital costs; in production—the right processes, the proper materials and the best planning; in industrial relations—good working conditions and the highest employee morale; in research—imaginative, highly-trained personnel equipped with the best apparatus and intelligent sympathetic leadership; in sales—an alert, aggressive organization selling properly-publicized, fairly-priced products; in administration—there must be skillful accounting, high-grade legal help, efficient purchasing, sound financing, and a great deal more. All these instruments must be kept in proper tune if the industrial orchestra is even to function. And a growth company requires even more—a near perfect balance and harmony.

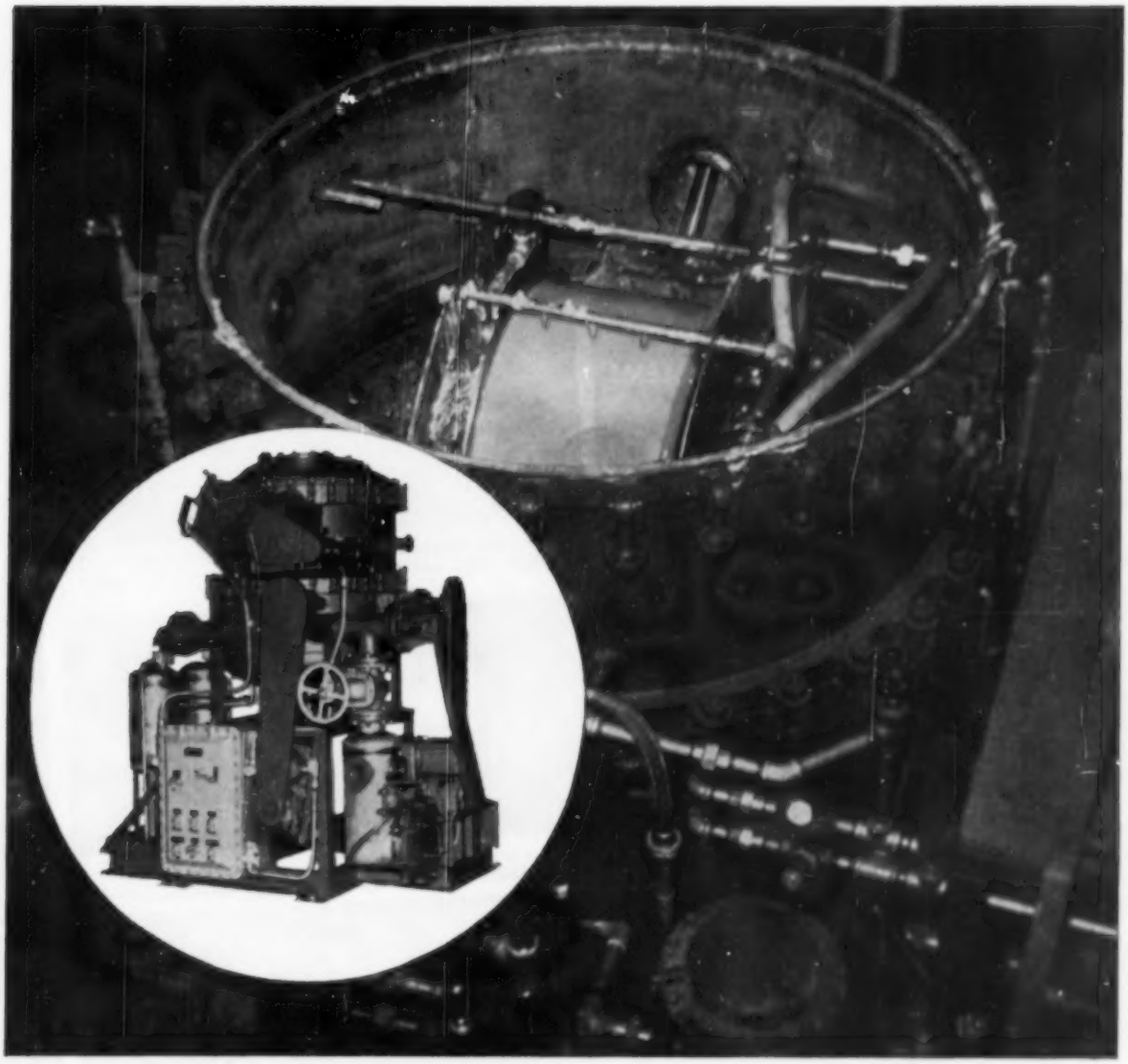
Achieving this harmony is management's principal function. If it succeeds, it does so by meeting decisively a deluge of day-in-and-day-out problems. It can meet these problems only by performing exceptionally well under what Lydia Strong, in an article in the *Management Review*, has called "The ordeal of executive decision." As Miss Strong pointed out, "The first group Dante met in the inferno were the wretched souls of those who could not make up their minds. They lived without blame and without praise. Heaven cast them out and hell would not receive them." The management of a growth company may have its wretched souls, but not because they are indecisive. You may be certain they are earning a welcome either in heaven or in hell.

*Robert Lindley Murray*
at *Society of Chemical Industry (American Section) Response to the Chemical Industry Award for 1956*

### "Time Is of the Essence"

The translation of new ideas from discovery through development to manufacture and use is a continuing problem of industrial research in the chemical industry. The essential difficulty does not reside so much in propagating a new idea but in persuading those concerned

(*Continued on page* 18)



# WE CAN'T SEND A SAMPLE

**Eimco's Research and Development Center has the answer for the plants with difficult filtration problems. The engineers at the Center know that under certain product conditions it is unwise for the laboratory to try to reproduce plant conditions in which the sample was taken.**

**The alternate is to provide test equipment at job site suitable for wide range filtration problems. Eimco has designed several units similar to the unit shown above that can be used as standard drums, precoating drums, pressure drums and pressure precoating drums. These units are also equipped for washing and can use several types of cake removal attachments.**

**Eimco's experience in over half a century of service to process industries has given them the advantage of understanding filtration problems. The need for developing and producing numerous types of filtration equipment gives Eimco more opportunity to serve the customer's needs.**

**Eimco's objectives are: 1. To solve the customer's filtration problem successfully. 2. To recommend the most practical and economical equipment suited to the job, and, 3. To give a stand-by consulting service in securing maximum benefits from the equipment.**

**Yes! When you have a problem in filtration, Eimco can help whether or not you can send a sample.**

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**Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City**

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B-107

# HORIZONTAL PROCESSING

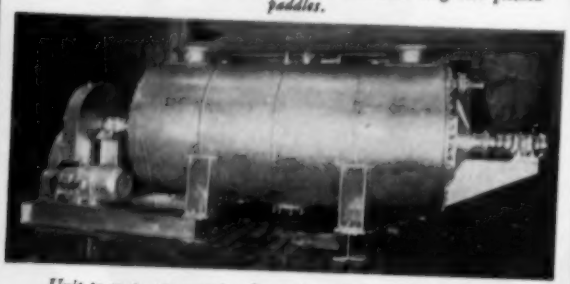
## may be the solution for your problem

**BETHLEHEM HORIZONTAL UNITS OFFER SOLUTIONS TO THESE PROBLEMS**

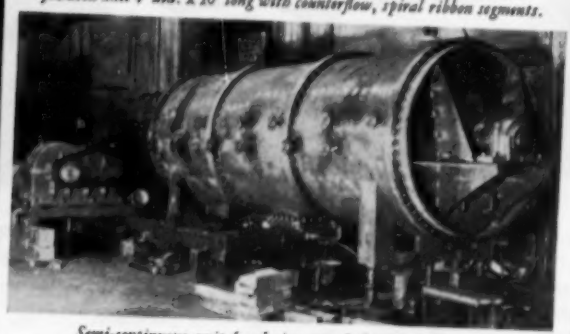
- Processing of High Consistency Materials
- High Heat Transfer Rate, Vigorous Mixing, and Intense Shearing
- Exposure and Renewal of Surface
- Minimum power input for required action
- Continuous or Semi-continuous Operation

**HORIZONTAL UNITS DESIGNED and FABRICATED TO SOLVE SPECIFIC PROBLEMS**

*Batch blending and heat transfer provided by this unit. Stainless steel, stud-bolted steel jacket, 4' dia. x 10' long with pitched paddles.*



*Unit to evaporate organic solvents from sludge. Fabricated steel jacketed unit 4' dia. x 10' long with counterflow, spiral ribbon segments.*



*Semi-continuous unit for drying ore sludge. 5' dia. x 16' long scraper surface dryer undergoing mechanical and hydrostatic tests in our plant.*

**FOR DIFFICULT OPERATIONS SUCH AS:**

- Evaporation of Water and Solvents from Slurries, Sludges and Pastes
- Reaction between Gases, Solids or Material of High Consistency
- Drying of Solids
- Continuous Reaction to Produce Formic Acid, Gypsum and Urea

**CALL ON BETHLEHEM'S YEARS OF EXPERIENCE**

in designing and building equipment to solve your horizontal processing application. We have designs which may be easily adapted to your process, or we can design units tailored to meet your need.

# BETHLEHEM FOUNDRY & MACHINE CO.

**PROCESSING EQUIPMENT DIVISION**

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1856 BETHLEHEM 1956 100th Anniversary

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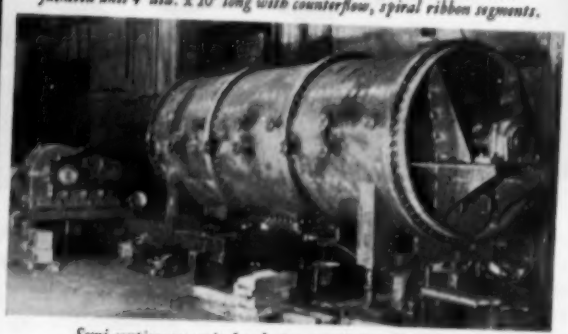

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## Noted and quoted

(*Continued from page* 14)

that "time is of the essence." Timely cooperation is the basic principle. If the research program is adequately constituted, once the project has advanced beyond the exploratory stage, a task force should be ready to handle it. This task force should have the advice of sales and production representatives, as well as of research people. The practical benefits of this combination are obvious: the introduction of external members early in the project will enlist sympathy in its cause and will relieve the research people of assuming the conduct of functions for which they are not qualified. Many projects have failed because research lacked either the will or foresight to present the new product to the sales department at a time early enough to ensure proper consideration. On the other hand, the obligation to cooperate must not outweigh either convictions based on scientific experience and sound technological judgment, and research must always be prepared to maintain its stand . . .

*J. J. Healy, Jr.*
in *Research Problems of the Chemical Industry. Industrial Research Conference*

### The Wide World—Engineer's Oyster

The modern engineering graduates can almost write their own ticket. The technical world which today's engineering graduate enters is the most exciting, the most challenging, and the most rewarding in history—and is becoming more so.

*G. Wesley Dunlap*
*Visiting Webster Professor at M.I.T.*

## Marginal notes

**Chemical Engineering Vol. II, Physical Principles of Chemical Process Design, J. M. Coulson and J. F. Richardson, McGraw-Hill Book Company, Inc., New York, and Pergamon Press, Ltd., London (1955), 570 pages, $9.00.**

*Reviewed by W. Henry Tucker, School of Chemical and Metallurgical Engineering, Purdue University, Lafayette, Indiana.*

This two-volume text on unit operations is perhaps the best available compromise exhibiting both technical competence and readability. Not only is it valuable in itself, but it will complement the excellent American texts available on the same subject.

(*Continued on page* 20)

# You'd move slowly, too...

# If you carried 97.8% LIMESTONE on your back!

It's true — our friend *"Speedy" The Snail's* house misses being pure calcium carbonate by just 2.2%.

But along the Norfolk and Western there are vast deposits of limestone that are even more pure — in fact, more than 97.8% calcium carbonate.

Some of these deposits are in mineable thicknesses of 100-foot veins, and in one location alone it is estimated that the deposit exceeds 100 million tons. Seldom has so much high quality limestone been so accessible for cement and chemical lime manufacturers — with markets nearby and dependable N&W transportation available.

Let us tell you about these valuable deposits, in detail, in confidence, and without obligation.

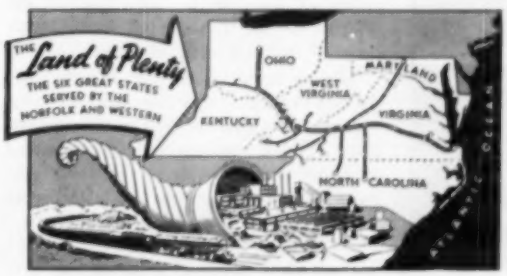
**And here are typical analyses ***

| | DHL-1-1 | DHL-1-2 | DHL-1-3 |
|---|---|---|---|
| SILICA ($SiO_2$) | .36% | .30% | .34% |
| IRON OXIDE ($Fe_2O_3$) | .072 | .043 | .049 |
| ALUMINA ($Al_2O_3$) | .21 | .20 | .19 |
| LIME (CaO) | 55.00 | 54.90 | 55.40 |
| MAGNESIA (MgO) | .65 | .62 | .51 |
| SULPHUR (S) | .012 | .011 | .015 |
| PHOSPHORUS (P) | .006 | .006 | .009 |
| IGNITION LOSS | 43.20 | 43.50 | 43.20 |
| CALCIUM CARBONATE (Calculated) | 97.90 | 97.72 | 98.51 |
| MAGNESIUM CARBONATE (Calculated) | 1.36 | 1.30 | 1.07 |

***Report prepared by Pittsburgh Testing Laboratories, Pittsburgh, Pa.**

*Write, Wire or Phone:*

**INDUSTRIAL AND AGRICULTURAL DEPT.**
**Drawer CP-713 (Phone 4-1451, Ext. 474)**
**Norfolk and Western Railway**
**ROANOKE, VIRGINIA**




**Norfolk and Western RAILWAY**

## Marginal notes

(*Continued from page* 18)

The second volume supposedly was to deal only with applications. A section on fluid flow through granular solids (preceding filtration and the centrifuge), and one on the motion of particles in a fluid logically appear to belong to Volume I which contains the major approach to chemical engineering science. The bibliography serves as a useful reference.

The second volume has a fairly extensive treatment of fluidization, but admittedly does not explain some current discrepancies among published data. The treatment on sedimentation is attractive because of the correct point of view that batch data can be applied to continuous sedimentators only after one makes specific assumptions. A chapter on gas cleaning is included.

The section on mass transfer applications appears to be quite good. In leaching, the difference point as developed will not be readily grasped by all readers. Also, the chapter begins with mass transfer coefficients and ends with nonideal stages without the notion that the two are related. The distillation chapter is an excellent balance between many topics which must be presented. The chapter on absorption is very readable. For the general case, however, the equations would be simpler if developed with concentrations in mole per cent rather than mole ratio. More emphasis should have been given to the equilibrium considerations which are brought out graphically by comparing the positions of the equilibrium and operating lines. An understanding of the flow rates and column temperature effects on tower operation should precede the study of rates of transfer. Not enough emphasis has been placed on nonisothermal operation which covers most large installations. The chapter on extraction needs a more extensive treatment on the mechanism of mass transfer.

Drying, which was included with evaporation and crystallization, logically should have appeared with humidification. This other important example of simultaneous heat and mass transfer appears in Volume I. The evaporation chapter is up to date but lacks treatment of enthalpy-concentration chart.

Mixing is presented with the chapters on size reduction and classification. This material on mixing was a disappointment. Old, erroneous material appeared along with new, usable correlations. Apparently no attempt was made to digest the available literature on the subject.

(*Continued on page* 24)

DU PONT

Better Things for Better Living ...through Chemistry

CHEMICAL ENGINEERING NEWS

PROPERTY AND APPLICATION DATA ON THESE VERSATILE ENGINEERING MATERIALS: "ZYTEL," "ALATHON," "TEFLON," "LUCITE."

# Ball valve seals of molded TEFLON® are chemically inert . . . withstand extreme temperatures and pressures

## Gaskets and packings of chemically inert TEFLON® are tough and heat-resistant

The opportunities for improved performance that TEFLON tetrafluoroethylene resin offers the chemical field is without parallel. Its use in process equipment saves money through reduced maintenance; lowered replacement costs; increased productive capacity (because of less downtime); reduced wear on piston, shafts, etc.; and simplified design. TEFLON may improve the quality of the product by eliminating contamination. In many instances, TEFLON has been found to be the only material that would give satisfactory performance.

Gaskets and packings of TEFLON provide exceptionally long life, which lowers maintenance, and cuts replacement costs and downtime. Because of the low-friction characteristics of TEFLON, the torque required to turn shafts or stems is minimized.

In addition to its use in gaskets and packings, TEFLON gives exceptional performance in such items as valve seats, discs, diaphragms, bearings, pipe and fittings.

**MOLDED BALL SEALS** of Du Pont TEFLON provide tight, long-lasting, chemically inert seals. This valve controls air flow in North American Aviation Corporation's F-86. Valve manufacturer is Koehler Aircraft Products Company, Dayton, Ohio; fabricator of the ball seals of TEFLON is Sparta Manufacturing Company, Dover, Ohio.

The unique combination of properties of TEFLON tetrafluoroethylene resin permits a practical and economical handling of fluids at high temperatures and pressures. In motor-operated valves, manufactured by the Koehler Aircraft Products Company, Dayton, Ohio, two ball seals of TEFLON provide a leak-proof seal, even when subjected to temperatures from −65°F. to 400°F. and pressures as high as 350 psi.

These seals of TEFLON retain their original size, whether they are in constant contact with hydraulic fluids, or water, air, and other elements which could cause swelling in ordinary materials. The extremely low coefficient of friction of TEFLON enables the ball to rotate easily within the two seals, opening or closing the valve.

TEFLON is chemically inert. It is suitable for use within the temperature range of −450°F. to 500°F. It is resilient and tough. This combination of properties recommends its use for diaphragms, seals, gaskets, packings and filters. Since TEFLON is unaffected by corrosives, its use greatly enlarges the range of materials a given piece of equipment can safely handle.

If your problem involves extremes of temperature and highly corrosive chemicals, a further look into the properties of Du Pont TEFLON may very well provide your answer. Clip the coupon below for complete property and application data.

## SEND FOR MORE INFORMATION

For complete details that will help you further evaluate Du Pont TEFLON for use in your product-development programs, mail the coupon at the right. Specific property and application data will be sent to you.

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Room 798 Du Pont Building, Wilmington 98, Delaware
In Canada: Du Pont Company of Canada Limited, P.O. Box 660, Montreal, Quebec

Please send me complete property and application data on Du Pont TEFLON.

I am interested in evaluating this material for

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City _____ State _____

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a New DENSITY HIGH
in
Concentrating Heat-Sensitive
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# *Use a Buflovak*
# ROTO-VAK
# *Concentrator*

It provides these PROFIT-BUILDING features:

- High concentration of a wide variety of heat-sensitive, viscous and foamy food products and chemicals
- Sterilization combined with concentration
- Increased capacity
- Lower operating cost
- Simplicity of operation
- Ease of cleaning
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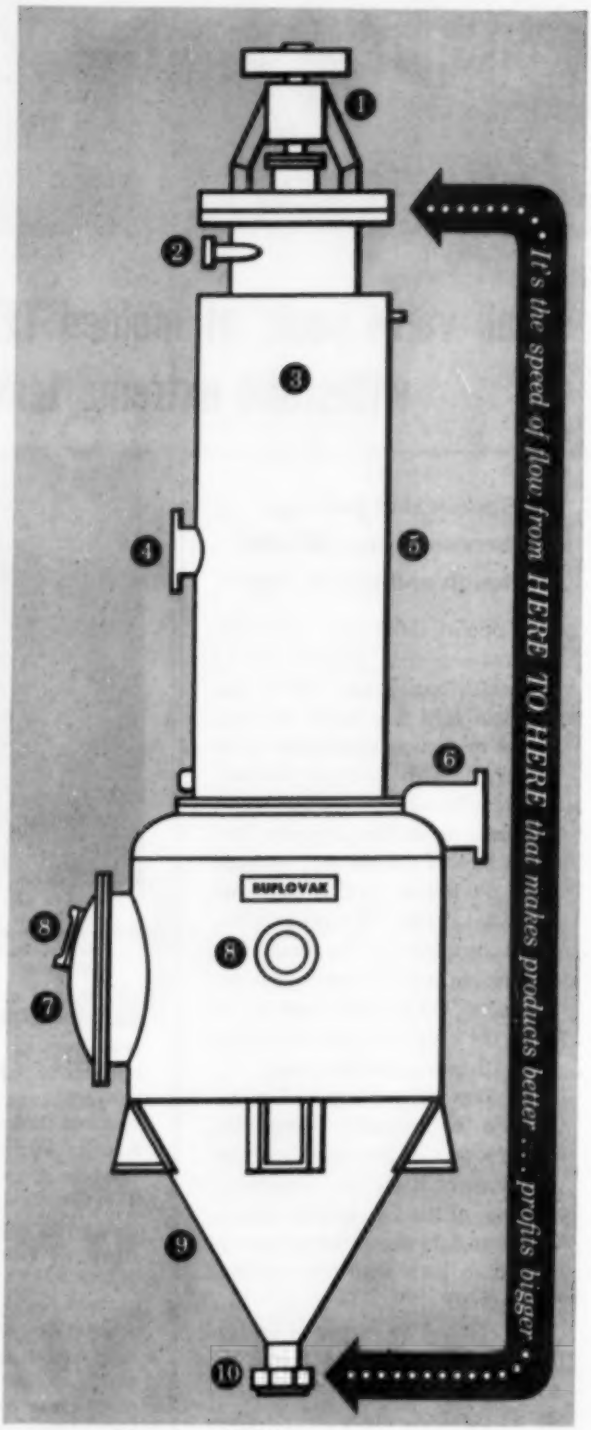
The Buflovak ROTO-VAK Concentrator employs the single pass, downflow principle, plus positive agitation. The combination gives entirely new results, with concentrations of many liquids carried to higher densities than can be satisfactorily accomplished in conventional type evaporators, retaining or improving desirable quality of the concentrated product.

The ROTO-VAK is extremely flexible, operating successfully through a wide temperature range and safely and effectively performing sterilization along with concentration.

We will be glad to test your product on a semi-plant scale with our laboratory model ROTO-VAK Concentrator in the Buflovak Research Laboratory and Testing Plant. Complete information on request.

ASK FOR BULLETIN NO. 369

50th Anniversary
BLAW-KNOX
1906-1956




(1) ROTOR DRIVE (2) PRODUCT INLET (3) INTERNAL VAPORIZATION TUBE (equipped with rotor to increase heat transfer) (4) STEAM INLET (5) EXTERIOR HEATING SECTION (6) VAPOR OUTLET (7) QUICK OPENING DOOR (for easy cleaning) (8) OBSERVATION GLASSES (9) CONE BOTTOM (10) FINISHED PRODUCT OUTLET (no recirculation)

## BLAW-KNOX COMPANY

*Buflovak Equipment Division, 1567 Fillmore Avenue, Buffalo 11, N. Y.*

DESIGNING ENGINEERS AND CONSTRUCTORS

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Early in 1956 the first full scale commercial installation in this country for the production of acetylene chemicals by high pressure techniques was placed in operation at Calvert City, Kentucky. It was engineered and constructed by The Lummus Company based on General Aniline & Film Corporation's design. GAF is the pioneer of high pressure acetylene technology in this country.

The chemicals presently manufactured include propargyl alcohol, butynediol, 1,4-butanediol, butyrolactone, pyrrolidone, vinylpyrrolidone, polyvinylpyrrolidone (PVP).

As a result of extensive research, pilot plant production and market development by GAF, these products already have wide acceptance industrially for use in cosmetics, pharmaceuticals, detergents, plastics and plasticizers, fibers, textile auxiliaries, solvents, corrosion inhibitors and germicides. With full scale commercial production now under way, industry will be able to obtain these materials at new low prices and in multi-million pound quantities.

The engineering and construction of this new and unusual processing plant required the closest cooperation between GAF and Lummus personnel at all levels, and it proceeded smoothly through a successful startup.

This project is one more indication of the ability of The Lummus Company to handle challenging installations for the chemical process industries. Look to Lummus when you have a unique engineering and construction problem.

THE LUMMUS COMPANY, 385 Madison Avenue, New York 17, N. Y. **Engineering and Sales Offices:** New York, Houston, Montreal, London, Paris, The Hague, Bombay. **Sales Offices:** Chicago, Caracas. **Heat Exchanger Plant:** Honesdale, Pennsylvania. **Fabricated Piping Plant:** East Chicago, Indiana.

# Marginal notes

(*Continued from page 20*)

Volume I, which was reviewed in August, 1955, *Chemical Engineering Progress,* page 14, was titled "Fluid Flow, Heat Transfer and Mass Transfer." The two volumes together admirably represent the English counterpart of the chemical engineering science approach to unit operations.

**Plastics for Corrosion Resistant Applications. R. B. Seymour and R. H. Steiner. Reinhold Publishing Company, New York (1955), 423 pages, $7.50.**

*Reviewed by G. S. Laaff, Manager, Research and Development, Bolta Products, Lawrence, Massachusetts.*

This work is designed to aid the engineer in the selection of the proper plastic material for a particular corrosive application. The tables are based on information collected from actual corrosion tests and from actual commercial experience rather than from a theoretical chemistry standpoint.

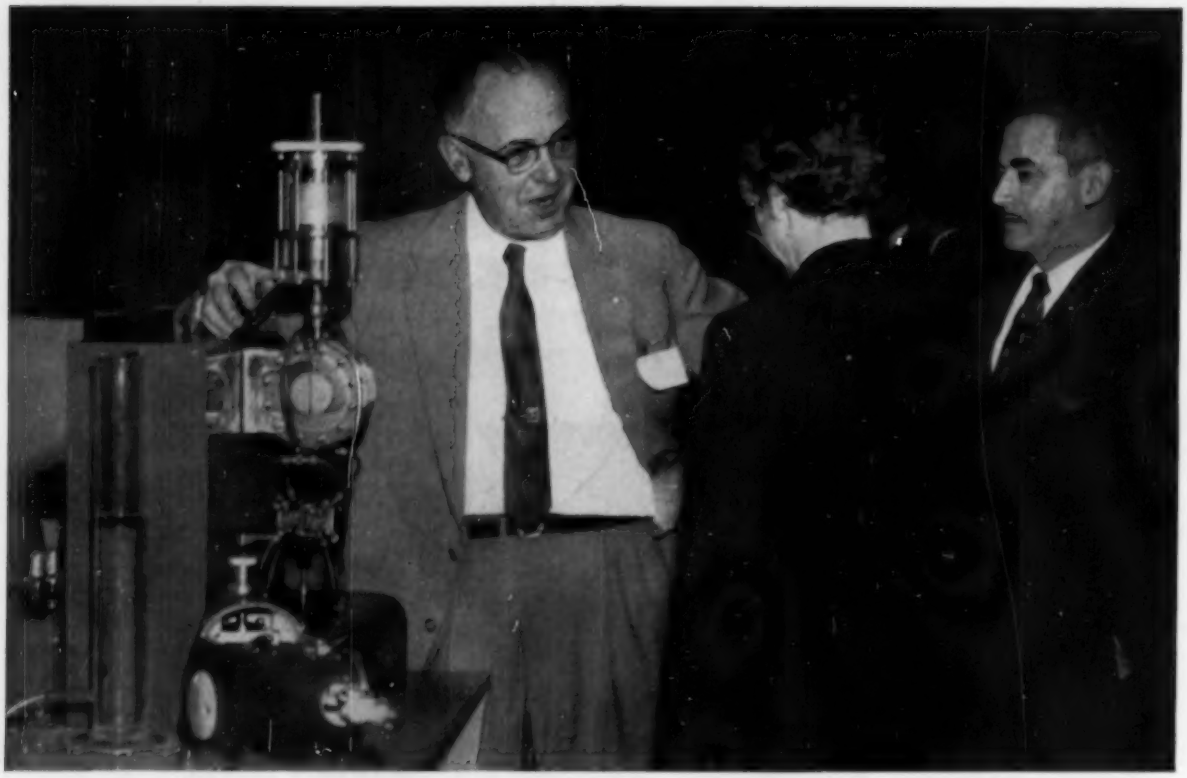
It is divided into five sections as follows: General Information on Plastics, Plastic Materials of Construction, Thermoplastic Applications, Application of Plastics in Masonry Construction, and a Plastic Selection Guide. The design engineer will find the fifth section—namely, Plastic Selection Guide, a noteworthy aid in the selection of proper materials for a particular installation.

The charts and tables included in the volume cover the subject more completely than any previous publication. Throughout, documentation is unusually complete, illustrations most informative, and references are made to many valuable articles on the subject.

Since the authors recognize that it is impossible to tabulate the effect of all reagents on all properties of all construction materials, they do give an excellent specific treatment of a broad subject.

**Turbulent Dispersion of Dynamic Particles. Vi-Cheng Liu. Engineering Research Institute, University of Michigan (1955), 24 pages, 75 cents.**

A problem of concern to meteorologists, chemists, and engineers is discussed in a report (PB 111958) of Air Force-sponsored research released to industry through the Office of Technical Services, U. S. Department of Commerce.



# IS SCHOOL OVER . . . *for any of us?*

Those of us in process control work realize that learning, too, is a continuous process. If we are to produce high quality products at minimum cost, we must apply the *right* tool for each process control job. Before we can select intelligently, however, we must learn and understand how all available tools work and how each is used. A rapidly expanding and changing technology further complicates the picture, with the result that school is never really over . . . for any of us.

An excellent instrument "refresher course" is available this year; the 11th Annual Instrument-Automation Conference and Exhibit, to convene at the New York City Coliseum, September 17th to 21st.

Instrument manufacturers will exhibit and describe their latest equipment. Classroom sessions will be conducted daily. Instrument users and manufacturers will learn more of product uses, and needs.

Milton Roy Company will be there, at booths 714, 715 and 716. We hope that we will have the opportunity to explain our equipment to you, and its application to your specific chemical metering needs. If you can't attend, then write for the "textbooks" listed below. They contain the "what", "why" and "how" of controlled volume pumping and, probably, the economical solution to your chemical feed problem.

**Bulletin 455** *"Controlled Volume Pumps in Paper Making"*

**Bulletin 953** *"Controlled Volume Pumps in Industrial Water Treating"*

**Bulletin 1253** *"Controlled Volume Pumps in Process Instrumentation"*

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milton Roy
CHEMICAL FEED SYSTEMS

## About our authors

Concerning the articles on Foreign Developments . . .

**Henry Schutte** (pronounced 'Shuh-tay') practiced chemical engineering in Sumatra after joining Standard of New Jersey in 1930. In 1935, he was on to Europe for Lummus, acting as a technical service and plant startup specialist. During the war, he was active in our butadiene program, becoming a member of the Technical Committee. Since the war he has been back and forth to Europe in Lummus' process interests, always with an eye on new developments. In 1954 he was made head of their Process Development Department which gathers together processes for license, with Europe being an important source. During the past year he was on three extensive trips to the continent, and is said to have written the outline for the article on the return leg of his last trip.

**Ralph Binney** entered the Foreign Division of Boston's First National Bank (which boasts 20,000 correspondents the world around) in 1922. Starting out as a foreign exchange trader, he later became a traveling representative on the continent for the bank's London office. As a vice president of the Foreign Division, Binney has come to be widely known as an expert on export, writing fluently and appearing as a speaker before business groups. The extent of his activities in the foreign field is indicated by the long list of organizations he serves as either a member or as a part of management.

About **J. C. H. Stearns** it can be said that the international aspect of his early life and career in Washington, D. C., probably had something to do with his present responsible activities in the foreign field for Dow. Leaving Washington, where he was a consulting engineer, in 1937, he joined Dow's magnesium activities, developing a market for the material in the midwest. In 1944 he became manager of ingot sales. After the war, as Dow's international interests grew, Stearns found himself drawn more and more into that sphere, developing European sales. Formal recognition came in 1954 when he was named to the Board of Directors of the Dow export companies. He was subsequently made executive vice president of both Dow International and Dow Interamerican.

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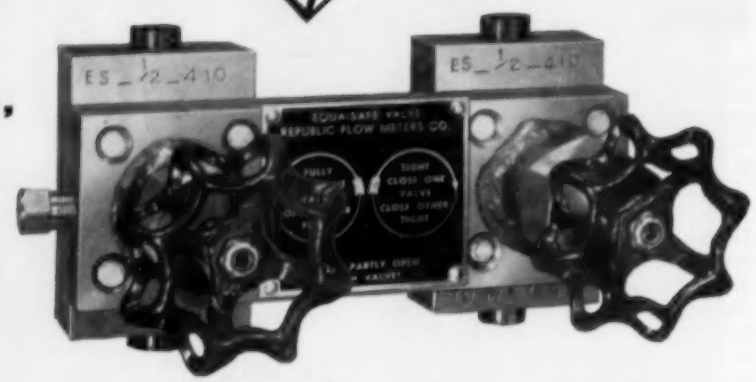


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No conventional built-up valve manifold affords the protection EQUA-SAFE *automatically* gives to differential pressure type instruments. And no built-up valve manifold can beat the low installation time or low maintenance required by EQUA-SAFE valves.

The "secret" of EQUA-SAFE's protection is in the common bridge-type bonnet and the two double-seating valves it connects. *When either valve is operated* (and sequence does not matter) *pressures in the two chambers of the differential instrument are automatically equalized through the bonnet.* As soon as both valves are fully "opened" (stem out) the instrument is on the line, with no leakage between sides. When both stems are in, the instrument chambers are interconnected and completely sealed off from primary connection pressures. Teflon packings are under pressure only while the stems are traveling from "seat" to "backseat", or vice versa!

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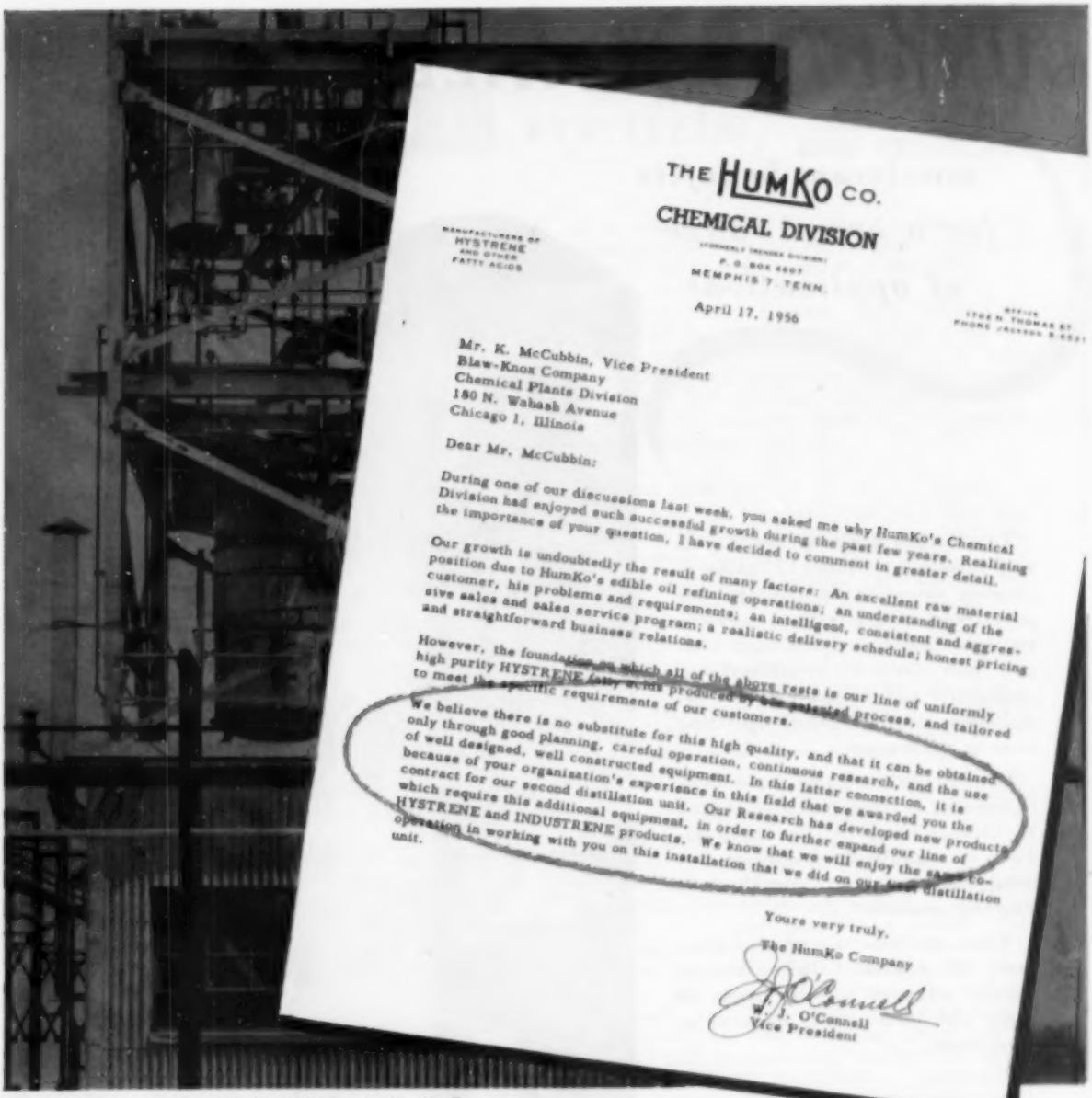


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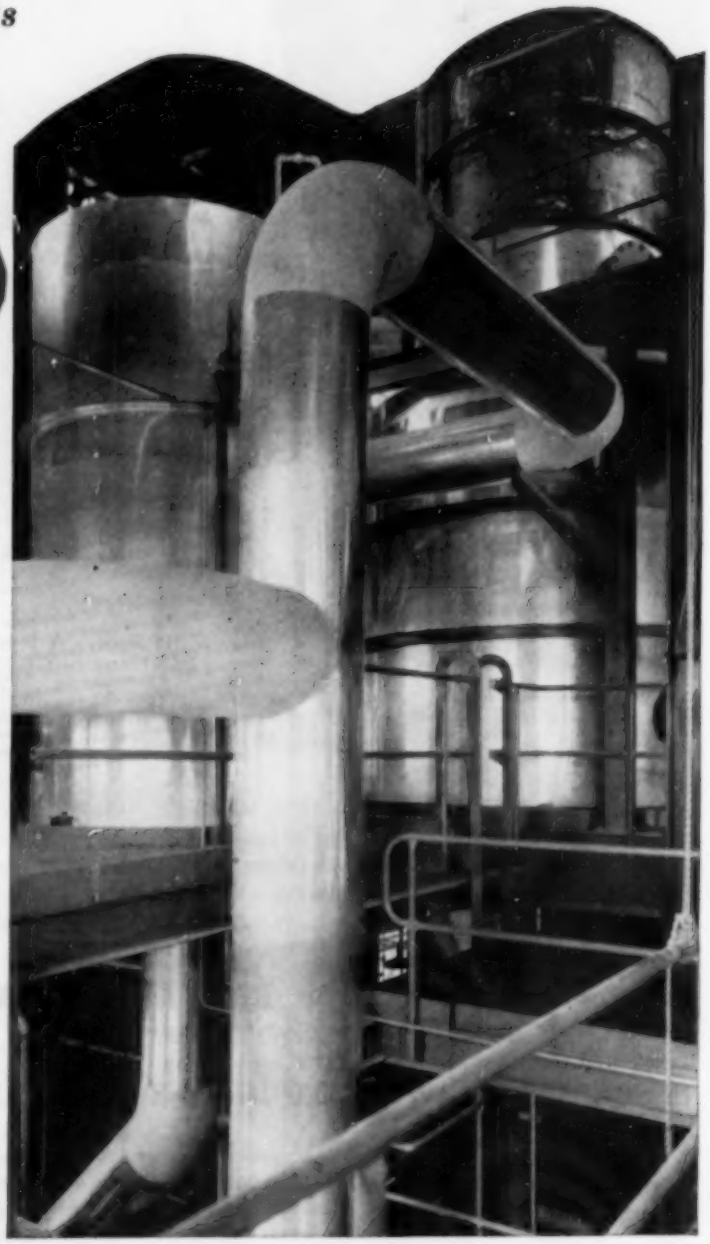

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# CEP trends / STEEL STRIKE AND CHEMICALS

In the midst of the summer doldrums, when the pace of industry slows somewhat to allow for plant vacations, the situation has been complicated by the nation-wide steel strike. Even though the labor difficulties have been settled at the time of writing, the effects upon industry will still persist through the remainder of the summer, because it will take the steel mills about a month after the men go back to work to return to normal functioning.

Some effects showed up early in the strike. General Electric closed down its industrial air conditioning equipment plant early in July and Westinghouse Air Brake will close a plant for the first half of August. Railroads and coal mines, of course, have already made large-scale lay-offs of workers.

Structural steel for building, and heavy plates —both of which are needed for the building of chemical plants and equipment— were in tight supply even before the strike started. One large construction firm announced early in July that a 30-day strike would mean that they would have to delay $150 million in new construction underway. Another big firm, St. Louis Shipbuilding, expected to shut down after a 30-day strike. Of course, industry usually sees labor trouble coming a long way off and endeavors to prepare for it as well as possible by running full time and filling up warehouses; much of this must have gone on in the months preceding the strike. Labor union leaders have charged that "warehouses are bulging" and that the steel industry would have run at only about 80% capacity and on a shorter number of hours this summer if there had been no strike. However this may be, it is likely that many firms have laid up inventories sufficient to carry them through for awhile, but steel is bulky stuff so what supplies they have can have been no more than a temporary stopgap. It would now appear that many chemical plant programs will be delayed in completion by up to a month, or possibly more.

### Foreshadowed Effects

Curiously enough, the effects of the strike were felt in some quarters well before it started. Sales of ferro alloys by firms such as Union Carbide & Carbon Corp. fell off sharply in June because consumers in the steel industry were looking for labor troubles. A similar situation arose in the buying of zinc by galvanizers who either cancelled orders or asked for delayed deliveries. Results of the strike showed up in the income figures of some concerns even for the June quarter because of the delayed buying in anticipation of trouble. Union Carbide, for example, which had been confidently looking forward to a record quarter in the second period of the year, instead showed a modest drop from this March quarter and will probably show even more of a decline in the present three months.

Union Carbide, of course, has a double kickback—both from its ferro alloys and from the sale of oxygen and acetylene to the steel mills (for cleaning and processing billets) and to the metal working industries. Air Reduction Co. is another that will feel some impact from its gas and equipment business.

### Effect on Coal Tars

The coal tar industry did not feel any important effect in the lessened supply of tar and by-products from the coke ovens of the steel industry. This is because the supply of coal tar chemicals at the end of June was ample and naphthalene for one was in large supply. The strike therefore was a help in cleaning up these inventories, but had it been protracted, there would have been serious shortages. There is, however, already a shortage in tars and pitches used as binders for the electrodes used in the electric furnaces of the aluminum industry.

The situation in benzol, a major and basic coal tar raw material, would be serious with a protracted strike. Large imports from abroad, even including some supplies from behind the Iron Curtain, have been helpful.

The chemical industry could have been hurt if the strike had lasted long enough to interfere seriously with automobile construction. The motor industry is one of the chemical industry's most important customers for finishes, for plastics and for many other items. Household equipment, including refrigerators, washing machines, and the like, is another major user of steel and also of plastics and finishes, and shutdowns here would have had a considerable impact on chemical producers.

### The Price of Settlement

Strike settlement means increases in the price of steel which will be passed along in higher costs for automobiles, home appliances, building and equipment. It is another important advance in the slow inflationary cycle which has been bringing higher costs to the chemical industry as well as to all industry over recent years. It obviously means that chemical firms who started major expansion programs under "certificates of necessity" for fast amortization since the war are in a favorable position. Plants built in the future will certainly cost more. Completion of amortization charges over the next year or so will mean that the plants will be carried on the books at a low figure and that the funds being laid aside as depreciation will go directly into increasing earnings.

CEP

# opinion and comment

## Now the Retired May Teach

IT HAS long been felt by many whose friends reach the age of retirement from normal industrial responsibilities that some means of encouraging these able people to teach something of their experience and know-how to the young would be extremely beneficial to engineering education.

Now a variation of this idea has come forth, and the circumstances surrounding the move are such that it might prove to be a starting point for a national movement.

In the case at hand, the New York City secondary schools are involved, and an effort is being made to explore the feasibility of mustering a part-time teaching corps made up of retired engineers and scientists. Subjects taught would include chemistry, physics, mathematics, biology, and related disciplines.

New York City needs, this September, the equivalent of 47 full-time science teachers to staff 235 science classes. As matters stand, an Advisory Committee on Science Manpower (appointed by the New York City Board of Education), is currently studying the possibility of recommending the utilization of the retired for an emergency program. Credit for the idea of using the retired goes to J. W. Barker, currently president of ASME, and a member of the Committee.

There are two problems to be faced. One is: will a sufficient number of the retired come forth and offer their services? The other problem has a bearing on the first. New York State's education laws require a minimum of eight semester hours in professional education courses before anyone can be licensed to teach in the city secondary schools. Such courses are not included in the degree requirements for scientists and engineers. To overcome this problem, William Jansen, New York City's Superintendent of Schools, stands ready to urge Commissioner of Education James E. Allen to consider modification of the present regulations on the basis of the emergency—if a sufficient number of applications from qualified retired men come in.

Although in New York City's case there are many 'ifs' involved, including the one having to do with licenses, there is certainly a wealth of talent in the metropolitan district. Whether or not the New York program gets under way as fast as is hoped and needed, it seems certain that other communities, perhaps with fewer problems connected with putting willing persons to work, could adopt this plan as the solution to their own secondary teaching problems.

Readers in the New York metropolitan area might get a great deal of satisfaction out of contacting a retired friend and encouraging him to look into the possibilities of taking a post at the blackboard—keeping one eye on the lesson outline, and the other warily pealed for paper wad slings and paper gliders.

In other areas, chats with the school and Board of Education people would plant ideas that might take root, and be of real practical aid in tiding the schools through a tight situation.

J.B.M.

All retired engineers and scientists interested in taking part in New York City's program should contact Mr. Samuel Schenberg, Board of Education, 110 Livingston St., Brooklyn 1, N. Y. A brief biographic sketch outlining educational qualifications and scientific and industrial experience should be supplied.

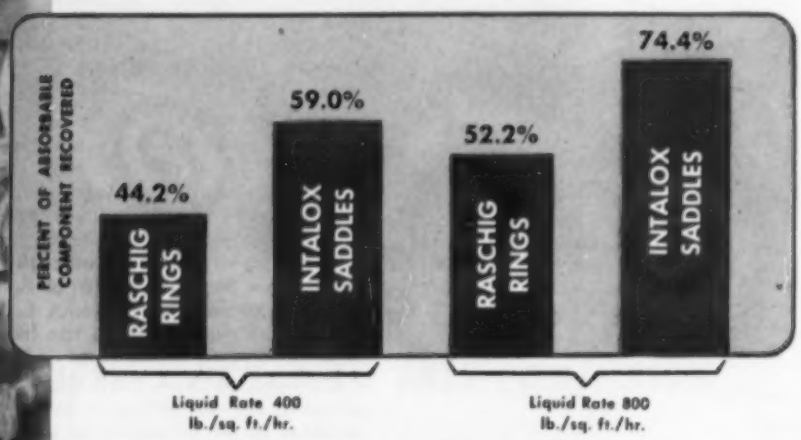
# HOW TO INCREASE ABSORBABLE COMPONENT RECOVERED WITHOUT INCREASING HEIGHT OF PACKED COLUMN

We alternately packed a pilot plant tower first with 10′ of Raschig Rings and then with 10′ of Intalox Saddles. Using identical gas and liquid rates and the same gas composition, absorption data for the two packings were obtained. One swallow, of course, doesn't make a summer, so we repeated the test again and again to be sure our original conclusions were justified.

If you're facing the problem of recovering a higher percentage of absorbable component from your present absorption towers, *it appears obvious* that you can increase the absorption level as much as 30% or more by replacing Raschig rings with Intalox Saddles. And without changing either liquid or gas rates!

Turning the problem around — if you're planning new tower construction for absorption operations — it appears *equally obvious* that tower height can be substantially less If Intalox Saddles are specified for the tower filling.

Actually, the increase in absorption level through using Intalox Saddles can be substantially greater than the test data indicates — for Intalox Saddles permit higher liquid and gas rates to be carried before flooding occurs.

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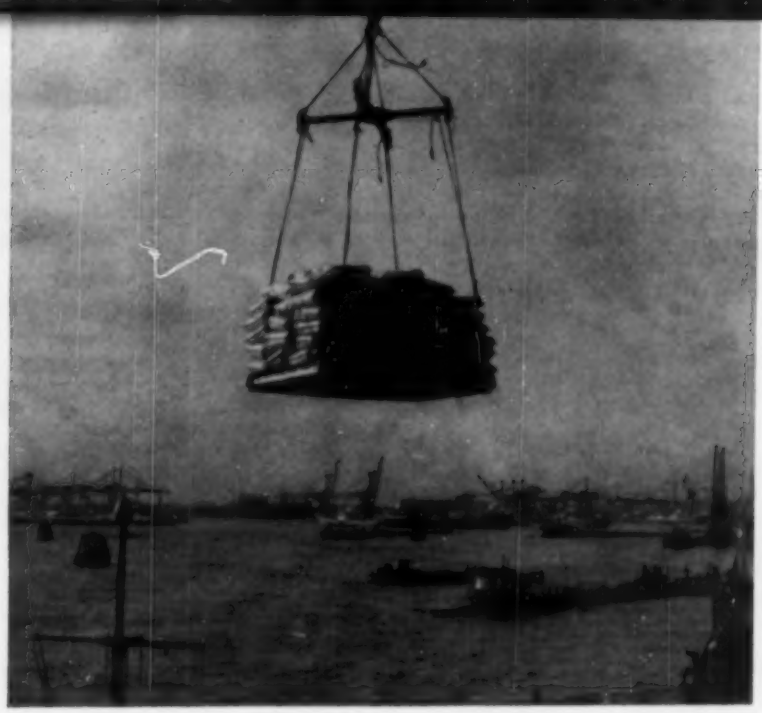
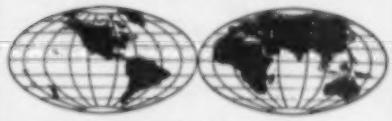


foreign chemical developments



and their effect on the U. S. chemical industry

View of the port at Woolhaven, Rotterdam, Holland.

# World-wide Chemical Markets and Their Effect on American Business

*J. C. H. Stearns* | Dow Chemical International Ltd.
Midland, Michigan

**World chemical production has increased greatly in the last fifteen years, particularly in the United States and in Western Europe. Simultaneously, international chemical trade has also increased markedly. Judging from statistics, it does not appear that any country is becoming entirely self-sufficient in chemicals. It would appear, rather, that this trade has proved of mutual advantage to the United States and to other nations.**

International trade is, of course, not a new phase of commerce for the United States; in fact, it was basically with this idea in mind that most of the early colonization attempts were organized. Naturally, the character of this trade was far different from that of today.

### Increasing Volume

A few figures regarding production and exports may help to establish present trends. Department of Commerce statistics from 1938, the last full prewar year, reveal that total U.S. exports advanced from about three billion dollars to approximately fifteen billion dollars at the end of 1954, a fivefold increase. During the same period U.S. chemical exports rose from $127,000,000 to slightly more than one billion dollars, which represented an increase of about eight times. In contrast, the United States imported chemicals in 1938 which were about 61 per cent as great as its chemical exports, whereas in 1954 chemical imports were only about 25 per cent as great. The American chemical export business, now at a billion-dollar level, has more than kept pace with over-all exports and is a significant percentage of our total chemical business.

For some segments of our chemical industry export business is long-established routine. For many, however, it was only a few years ago that the following questions were being asked:

**How does one sell in export?**

**Is foreign business temporary or can it be a permanent part of the total business?**

**Is foreign trade profitable?**

**Can one really sell in competition with other countries and in the face of import-export restrictions and soft currency?**

### Chemical Export Beginnings

For many American chemical firms, exporting started with an inquiry from an export broker or export merchant in New York, New Orleans, or San Francisco. The broker merely asked for price and delivery to a port or to his warehouse and stipulated a 5 or 10 per cent commission for his services. Often, the broker or merchant also marked up the price of the product so that instead of getting only his commission he sometimes realized 20 to 40 per cent. Nevertheless, if the product was available, the producer was glad to sell at his regular price and, consequently, this type of business tended to increase.

Filling tankcars of Chemische Werke Hüls at Nieuwe Matex.

### FOREIGN REPRESENTATION

For some companies the volume going into export proved substantial and, sooner or later, management began to wonder whether their companies would not be better off if more direct sales representation were set up. This called for investigation of foreign markets on a more realistic basis and usually resulted in the appointment of exclusive representatives to cover one or several countries. With such arrangements, there was usually a stipulation that the agent would sell at prices set by the manufacturer and at a fixed commission. Furthermore, the agent was authorized to handle only a specific group of products and was not permitted to sell competing products without permission from the manufacturer. Sometimes a member of the agent's staff was even brought to the home manufacturing plant for training purposes. The net result of this policy was that the agent became a closer member of the selling team than if he had been merely a manufacturer's representative.

### SEPARATE EXPORT COMPANIES—ADVANTAGES

Generally speaking, a well-organized foreign agency setup results in a much improved sales effort; customers get better attention and have more confidence in the supplier's reliability. However, it soon becomes apparent that an agent operating on his own, several thousand miles away from the producer, needs direct supervision and encouragement. At this juncture, the producer may well consider forming separate export companies with specialized personnel. In certain areas of the world, he may also find this advisable from a tax standpoint. In addition, the establishment of overseas sales offices leads to more direct liaison with the agents themselves as well as to occasional actual contacts with customers. Many American companies have found that this is an effective means of acquiring greater knowledge of their foreign markets, of selling methods, and of their customers.

#### Technical Service a "Must"

In these days, technical service and development, along with sales personnel, are "musts." In many fields where chemicals find application, it is necessary to offer the customer technical assistance in the use of products.

Particular instances are the use of latexes in paints and paper coatings, the molding of plastic materials into finished products and the correct application of agricultural chemicals, such as insecticides, herbicides, etc. Usually, this increase in sales and technical personnel operating in foreign markets soon points up the particular markets which should be exploited, indicates specific sales approaches to those markets, and shows where return and potential are most attractive.

In areas where marked illiteracy still exists, the ultimate in technical service is required; by this is meant actual demonstrations of product use. Mere supplying of technical literature and instruction sheets is not always enough.

The last step, of course, is the manufacturing subsidiary or associate company abroad. There may be circumstances under which it is no longer possible or profitable to sell a finished product in a given country. On the other hand, it may be possible to manufacture the same finished product in that country, either through a wholly owned subsidiary or through an associate company.

#### Dow's Export Organization

The foreign sales organization of The Dow Chemical Company offers an interesting illustration of the phases discussed above. Dow has two export companies, one known as Dow Chemical Inter-American Limited, which is responsible for sales to all countries in the Western Hemisphere outside the United States, and Dow Chemical International Limited, which is responsible for sales throughout the rest of the world. The primary reason for the two companies is one of taxation. Under Sections 921 and 922 of the Internal Revenue Code, the income of a corporation which limits itself to the sale of products to countries in the Western Hemisphere outside the United States is subject to a tax of only 38 per cent compared to the normal corporate income tax of 52 per cent.

During the last four years the Dow export companies have established four overseas supervisory offices—in Zurich to cover Western Europe, the Mediterranean and Africa—in Montevideo, Uruguay, to cover the countries of South America with the exception of Venezuela and Colombia—an office in Mexico City to cover Colombia, Venezuela, Central America, Mexico, and the Caribbean Islands—and one in Tokyo, Japan, to cover the Far East. These offices operate under the management of American personnel but employ natives of the country in which the office is located.

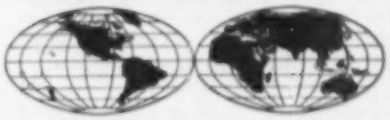
The Dow companies also have two branch offices in the United States—one in New York and one in San Francisco—which have dual functions. First they are primarily service offices for documentation, handling orders, and booking ocean space. Second they have the sales function of working with U.S. export merchants, and resident purchasing agents of foreign customers. It is probable that in the future Dow will make subdivisions of the large territories mentioned above and will establish resident supervisors working under the area office to increase direct contact with customers and markets.

The fifth area—Canada—is covered by Dow Chemical of Canada Limited, which manufactures in Canada and is also the exclusive representative in the Dominion for Dow chemicals manufactured in the United States.

Dow also has several associated manufacturing plants abroad. An example of this is the Asahi-Dow Chemical Company in Japan, which is owned 50-50 by Dow Chemical International and the Asahi Chemical Company. This joint company was established to make saran filaments: Dow, in effect, sold its process know-how and continues to sell some raw material to Japan.

#### Analogy with Domestic Market

These various developmental and organizational changes are actually similar to those through which American concerns have passed in selling the domestic market. In many cases, a manufacturing company has started out selling its product solely through wholesalers, distributors, or manufacturers' agents. As the company grew, sales personnel was added to supervise these agents and, eventually, sales offices were established in various parts of the country. In certain fields, companies may retain the distributor who performs a real function for them. Technical and development staffs are often added.







Even the establishment of associated manufacturing plants abroad has its analogous phase in the United States. Because of high transportation costs and long delivery times, many companies have set up additional plants in various parts of the United States to meet competition and to give better service to their customers.

Thus, at least in terms of methods, there are many similarities between selling in the United States and selling abroad.

#### Manifold Obstacles

There are numerous aspects, however, in which the problems and obstacles are entirely different. Except for countries adjacent to the United States, such as Canada, Mexico, and the Caribbean Islands, foreign markets, merely from the standpoint of distance, time, and difficulty of communication present a much more complex problem than would comparable distances in the United States. Delivery of materials via ship from the United States to Western Europe, for example, is a matter of three to six weeks depending on sailings, weather, and customs delays. A letter takes three to five days, sometimes longer, to go from here to Western Europe by air mail. In the case of the Far East, it takes nine to fourteen days for an air mail letter and, although cables will arrive the next day, they are expensive and their content is necessarily limited. Hence, in foreign trade, one does not have the ability to talk to a customer or even to one's own people as quickly and completely as would be possible in this country.

#### PAPER WORK

The matter of documentation can be fantastically complicated. Back in the days when a U. S. company sold only to an export merchant or broker, it had to provide certain extra markings and documents. It did not, however, have much responsibility for this paper work since the documents were usually provided and checked by the export merchant. However, as the company's export business began to grow and it began to take over some of this work, the company suddenly learned that there was a tremendous amount of paper work involved in shipping materials from this country to another. This paper work included such items as ocean bills of lading, export licenses, letters of credit, import licenses, import certificates, U.S. export declarations, consular declarations, weight lists, certificates of analysis and certificates of origin, all of which have to be filled out in numerous copies exactly as called for on the export and import licenses. If there is the least deviation, the material may be held up in customs in the country of destination for weeks.

As an example of the work involved, Dow has in its export companies forty-five people, exclusive of secretarial help, who are primarily engaged in documentation over and above the simple shipping paper and bill of lading required within the United States.

There is also the question of restrictions which foreign countries as well as our own have placed on imported goods. Some countries have import quotas on certain products, others require import licenses, others have duties, and some do not permit imports of certain products at all.

#### "Hard" and "Soft" Currencies

The terms "hard currency" and "soft currency" are widely used today in international financial circles. Generally speaking, a hard currency is one that is in great demand throughout the world since it will be accepted without difficulty in almost any country. On the other hand, a soft currency is characterized by relatively small demand in the world market: it is accepted as payment in comparatively few countries. Thus, one may have a customer who earnestly desires to buy but who does not have dollars with which to pay. He can, perhaps, offer pesos, francs, bolivars, or cruzeiros, but these are often not acceptable to the financial management of American companies.

#### The "Switch Sale"

The above situation has led to the interesting transaction known as the "switch sale" or "triangular sale," in which the American company receives payment in U.S. dollars and the customer is able to pay in some other currency.

Briefly, switches are fostered by trade agreements between two given countries. These agreements establish a pipe line for payments which are expressed in a currency acceptable as a standard for both countries such as U.S. dollars or transferable pounds sterling. This is called clearing currency. Payments within this pipe line are made by means of bookkeeping entries; the currency does not pass physically between the two countries. The countries signing the agreement authorize banks to handle the debits and credits and these banks receive from and pay to the importer and exporter, respectively, in the national currencies. The switch enters this pipe line when the exporter, acting as a switch agent, sells materials from a third country and disposes of the national currency for hard currency which can be remitted to the third country.

Taking a concrete example, one can assume that a buyer in Argentina, a soft currency country, is buying American chemicals, and Holland is used as the switch partner. The U.S. concern ships the chemicals to Holland, and they are then reshipped to the Argentine customer. The switch agent in Holland purchases a "switch right" from the Dutch government, paying a premium of anywhere from 1 to 10 per cent of the total transaction. The Argentine customer pays his bank in pesos; the Argentine bank credits the Dutch bank in clearing currency; the Dutch bank pays the Dutch switch

Reception room at Dow Chemical offices in Mexico City.

agent in Dutch guilders; by virtue of the "switch right" the Dutch agent can convert guilders to dollars and remit dollars to the United States concern.

In transactions such as these the costs include handling and disposing of currencies, banking charges, and charges for arranging documentation. Premiums charged by switch agents to cover these costs will range all the way from 1 per cent to as high as 64 per cent of the total transaction. They vary according to the country involved, the demand for, and the availability of, currency, and the amount of risk the agent feels he is taking. The premium, of course, also includes a profit for the pivot trading house or bank; if an additional switch agent in the United States or in the customer's country is brought into the transaction, there has to be an extra markup for him.

The governments of some switch countries officially approve this type of transaction and profit from it by charging fees for switch rights. These are countries that normally have a good supply of foreign exchange. Other countries in less favorable financial circumstances do not always recognize this practice officially and the American company and its customer run the risk of having to pay a penalty to get the goods through. In many cases, however, the switch transaction has proved to be the only way in which U.S. chemical concerns could sell their products to some countries and obtain dollar payment.

#### Prices and Cartels

Pricing is another factor in selling abroad which in many cases is quite different from customary business practice in the United States. In this country, most chemical companies have published prices for the products which they market. For materials of like quality, these prices are likely to be the same all over the country regardless of the manufacturer or his location. In selling abroad, one may find that prices are far less stable and that, under normal conditions, they are likely to be somewhat lower than prices for the same product in the United States. The opposite can be true, however, when one considers that the cartel system, which is often adopted by foreign producers, is a perfectly legal and approved marketing procedure in a number of countries. The cartel system usually is limited to countries that have sufficient material of their own, both as to quantity and quality, to satisfy the home market. The cartel therefore does everything in its power to maintain prices, through price-fixing associations and other such media. But in most instances where American chemical products can be sold abroad, price levels are often lowered through efforts of competing producers' representatives and local purchasing agents. Such situations, as might be expected, have been known to cause bitter resentment on the part of local producers.

#### Dumping Out of Date

In the past, many American concerns have looked on sales abroad simply as a way to get rid of their excess U.S. production, and have been willing to unload this excess capacity at almost any price. However, in the years since the war, many companies have taken a more constructive and longer point of view of their export market and are coming to the conclusion that their best interests are not served by dumping at low prices in bad times and dropping out of the market in good times, but rather by attempting to maintain a stable price and supply situation to build a more lasting market. We can only hope that this more constructive practice will be of benefit to producers and consumers on both sides of the water and that it will result in better and more profitable foreign trade.

#### Longer Credit Terms

The chemical industry in this country, generally speaking, operates its business on 30-day terms of payment where the financial standing of the buyer is sufficient to warrant open-account credit. Business abroad is often conducted on an extended credit basis, varying all the way from three to five years for capital goods down to sixty to 120 days for chemical products. This does not necessarily mean that the customer does not have the money to operate on a shorter payment basis; it is simply that such terms are a matter of general practice.

#### Foreign Sales Potential Unlimited

As one would expect, those countries which are furthest ahead in industrialization also tend to be this country's largest customers for chemicals. Interestingly enough, this is true even of those countries that have excellent and sizeable chemical industries of their own. In Western Europe, for example, where the chemical industry has made great strides since the war, more chemicals from the United States are being sold than ever before. It is possible, of course, that this situation will not long continue. But there are still large areas of the world which are growing at a rapid pace and which are at the very beginning of their industrialization. It can be expected that such regions as South America will tend to grow in importance as a market for U.S. chemicals.

#### Expanding Advertising

Advertising, promotion, and market research abroad on the part of American firms has been rather limited, but in the last few years considerably more attention has been paid to this phase of selling. This development is natural in a way, since in order to advertise properly, one must have a sales force to follow up and take advantage of the advertising.

At the start, Dow did only a limited amount of foreign advertising, usually in what are known as international media, such as *Time Atlantic, Life International*, or *Readers Digest*. However, with an increased sales force and more direct access to a knowledge of the market, it has now instituted a much more comprehensive program. The same is true of other American chemical concerns which have a substantial and long-range interest in the export field. As an example, Dow's program today makes use not only of the international media of the type mentioned above, but also of local media in the various countries. This year Dow is planning well over 500 advertisements in eleven languages and in more than fifty different publications.

More and more companies are tending to get out promotional literature specifically aimed at the foreign market, often in the language of the country involved. As competition from U.S. and other chemical producers in the world becomes keener, it can be anticipated that the use of advertising and promotional material will gain in importance as a means of retaining and increasing a position in the export field.

Market research, as it is known in this country, does not, for the most part, exist in foreign countries. The tendency abroad is to be much more secretive with production and sales information. Established agencies for gathering reliable and accurate facts are only starting in many parts of the world. Although quite a few U.S. chemical concerns interested in export have market research staffs, they are, for the most part, only beginning to scratch the surface in using this tool as a part of their companies' sales efforts abroad. It is expected that this phase of selling, like advertising, will continue to grow and that as more data and more familiarity with foreign markets is available it will prove its value abroad as it has in the United States.

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*Presented at A.I.Ch.E. meeting, New Orleans, Louisiana.*

# COMMERCIALIZATION ABROAD OF U.S. TECHNOLOGY

**foreign chemical developments**

**and their effect on the U. S. chemical industry**

*Ralph M. Binney* | Vice-President, First National Bank of Boston
Boston, Massachusetts

It would be naive to lay down specific lines on how to conduct business overseas for there is no definite formula. Every day the rules change and the policy that should be pursued varies with company, with product, and with the country involved. Therefore, in foreign trade one must be indeed versatile and flexible.

Obviously, capital goods require one kind of approach and consumer goods another. How to sell or whether to manufacture abroad depends entirely on the ultimate customer, the potential market available, the risks to be assumed, and the profit possibilities.

Some techniques used for manufacturing overseas, both through license and royalty arrangements, or by production through a branch or subsidiary company are outlined below.

### Prior Investigation

In either case, one of the first things the American company has to consider is the investment climate of the country in question. This is basic, for unless the following points add up favorably, the company probably will not want to expand in that market.

1. Market potentialities, especially the opportunity for long-range growth and development.
2. Profit possibilities, particularly for remittance of royalties or earnings on capital within a reasonable time.
3. Tax incentives, if any, given for the establishment of a new enterprise that creates jobs. Many countries, such as Holland, Belgium, Ireland, and Italy make interesting proposals to American manufacturers, taxwise and otherwise, in their efforts to attract new industries beneficial to their economy.
4. Reasonable assurance from proper authorities that the necessary foreign exchange will be available for essential raw materials or semi-finished goods in order to insure continuous production. If the proposed new plant is going to create foreign exchange by reducing imports or by producing exportable products, the American company will probably be welcomed and well treated.
5. Available labor supply, electric power, and water. These are important factors to study in most countries overseas.
6. Social legislation, labor regulations, price controls. It must be determined that these details will not hamper successful operation.
7. Protection of trademarks, formulas, and the market now enjoyed. If the proposed agreement is on a license and royalty basis, such protection must be assured and the markets in which the licensee may sell must be specified. Otherwise, he may compete with the American manufacturer outside his own country because of lower production costs and other factors.

### License and Royalty Agreements

In a license and royalty arrangement one should first find out everything possible about the company it is proposed to license—its financial status, management, business ethics, moral integrity, and its ability to make the product to American standards. The licensee company may need help and guidance on this last-named score, and some assistance will probably be part of the arrangement, but the foreign company and its plant must be studied carefully to ascertain its capacity for the job even after technical assistance and know-how have been given by the American company.

In addition to the usual royalty arrangements, an agreement should cover other points, such as

Administration charges
Engineering fees
Cost of training some of the foreign company's staff in America
Cost of sending engineers and production specialists abroad to assist in setting up production lines and giving the business the benefit of special techniques
Arranging for taking a stock participation in the foreign company for additional profits.

### Manufacturing Abroad

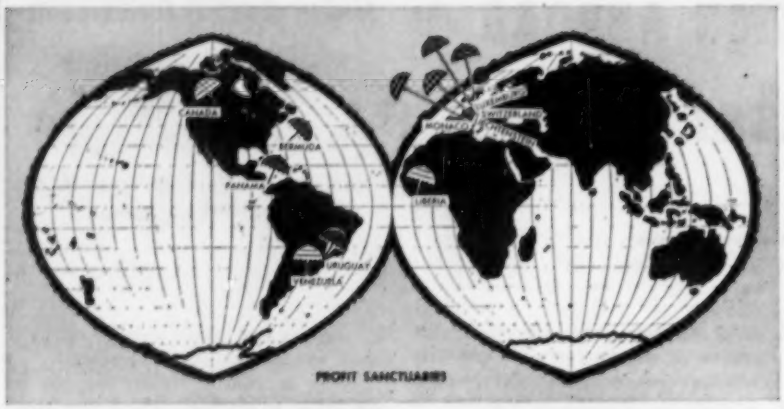
If a plant is to be set up in a foreign country, with or without local capital participation, the same fundamental factors listed above apply here. If these check out satisfactorily, one must then determine whether to own the foreign company 100 per cent or take a majority of the stock and have some local partners participate. This could, of course, vary by country and would depend on local laws, and nationalistic tendencies.

There is no one formula that can be applied to all markets. The writer however, is of the opinion that there is merit in having some reliable, native stockholders participating in the enterprise, serving on the directorate, and perhaps even holding managerial jobs in the foreign subsidiary. There are many reasons for this policy. First, dependable local shareholders will take a personal interest in the venture and, since they are in an excellent position, will further the project on the local scene. In addition, such a technique gives the overseas subsidiary a native flavor that frequently makes it more acceptable to the general public as well as to the government, and therefore, the enterprise is less likely to be attacked or expropriated in times of extreme nationalism or political upsets. To the extent that native participation is permitted in a venture, the American investment in dollars is reduced with a correspondingly smaller foreign exchange exposure.

Canada—America's closest neighbor—is a good case in point. Many recent newspaper stories have publicized the resentment that has developed in that country against American branches and subsidiaries because many of them have gone there in recent years with projects in which there was no Canadian participation. Most of them have operated successfully and profitably, and the net earnings have been transferred to the United States for the benefit of the stockholders here. A majority of these branch plants have presented real competition to local manufacturers, and the Canadians feel that the Americans are now getting too large a slice of their desirable business, particularly in the new growing industries.

### Good Neighbor Investment Policies

A large American company has recently set up a new manufacturing operation in Toronto on what appears to be a sound basis, and it has been welcomed by the Canadian Government and the public alike in spite of the recent blasts in the press. This company has a typical Canadian name, not American; three of




the seven original directors were carefully selected Canadian businessmen of good reputation. Forty per cent of the stock has been sold to Canadians, and the directors hold only a small percentage of it, the balance being sold to the public. The general manager is a Canadian, well qualified for the job and with a good knowledge of the Canadian market. The company here could have given that top job to an American, but it elected not to do so for policy reasons. With the exception of a few specially skilled technicians and engineers from the United States, the other staff members are Canadian. On this basis, everyone is working enthusiastically and harmoniously and Canadian Government officials have been cooperative.

#### Limitation of Financial Risk

When planning to expand in a foreign country, management here naturally wants to reduce its exposure in foreign currency as much as possible, particularly if there seems to be some likelihood of exchange depreciation. This can, of course, be accomplished in many ways, and is dependent on local conditions.

If an American company is willing to take in some local partners who may be willing to buy the land and put up the building as their capital contribution, then the American company can contribute the machinery, engineering skills, designs, layouts, and technical know-how. On the basis of the balance sheet, a line of credit is set up to take care of short-term working-capital requirements.

If a fairly substantial cash contribution is necessary, this can sometimes be arranged by borrowing from a local bank with the guarantee of the parent company here; thus, the transfer of funds overseas and the attendant exchange depreciation exposure are avoided. If a bank loan is not feasible because of certain circumstances, it is sometimes possible to borrow the local currency from some American company that has a surplus available. This organization might rather loan its surplus to another financially sound American company than invest it in local bonds or other more precarious investments.

In some countries, monetary exchanges can be arranged so that the American company has the use of local currency for six months or a year at a fixed rate and interest cost. Such a modus operandi also eliminates the peril of exchange depreciation.

#### Washington's Role

Recently the Secretary of the Treasury, through the National Advisory Council on International Monetary and Financial Problems, decided to lend American firms some foreign currencies acquired as payment for United States farm surpluses sold abroad under Public Law No. 480.

In Colombia, for example, the United States proposes to lend $10 million of Colombian pesos, but it requires that the borrower repay as many pesos as will then be needed to equal the amount of the loan. No businessman in his right mind would make such a guaranty and assume the exchange risk to borrow foreign currency, hence the proposition is obviously unattractive.

However, a large amount of wheat was recently sold to Brazil on a cruzeiro basis and 76 per cent of the proceeds, equivalent to $30,900,000, is to be set aside for economic development loans in Brazil. The balance of about ten million dollars, if a supplemental agreement is signed, would be loaned to American firms operating in Brazil at 3 per cent if the loan is repaid in dollars, 4 per cent if repaid at "an exchange rate to be determined at the time repayment becomes due," and 5 per cent if the number of cruzeiros that were borrowed are repaid. The latter is obviously the only attractive method of borrowing, particularly with the prime rate in Brazil currently about 12 per cent and some loans running as high as 18-24 per cent a year. One interesting clause in the agreement states "there is to be no discrimination against an application made by a U. S. branch or subsidiary in Brazil . . .," a curious provision since all the money being lent belongs to the citizens of the United States. The United States Government has agreed to accept 50.06 cruzeiros for every dollar on this sale, thus with the free market at 71 to the dollar, already a 30 per cent loss has been taken for the United States taxpayer.

Some sales of surplus commodities have been made recently to Argentina on a similar basis; hence, if pesos are needed for expansion, the possibility of obtaining them from the United States Embassy in Buenos Aires should be investigated.

In several foreign countries one can acquire blocked exchange at a discount for reinvestment within the country and this can frequently save considerable money if one is building a new plant or putting additional capital into a branch or subsidiary company for expansion.

#### Special Currency Areas

Depending on the country in which it is intended to operate and the kind of product to be sold, one may find it advantageous to have a Western Hemisphere trade corporation or a Pan American corporation handle the business in this hemisphere. In the chemical industry where packaging is a problem, an arrangement might be effected easily and practicably.

It might be an advantage also for a foreign subsidiary or associated company to assemble, manufacture, and sell within the sterling area. Scotland and Ireland are both anxious to attract more industries, particularly American, and they offer many inducements, taxwise and otherwise, to new firms that are going to create employment and help the economy of the country.

England itself has for generations been a popular spot for many American firms to operate branch plants and, all through the difficult war period, the Bank of England permitted the remittance of dividends and royalties in dollars.

It may, perhaps, be found desirable to operate in one of the soft currency areas in order to cover certain markets properly. Italy, for example, has just passed a new foreign investment law which makes it more attractive for American companies to establish branches or subsidiaries there.

# foreign chemical developments

## and their effect on the U. S. chemical industry

**Technique Applied Abroad**

**The minute operations are begun through a local company in a foreign country, one moves into a domestic operation and business must be conducted accordingly. The techniques of production, market research, advertising, and sales promotion—all of the resources used by the parent company here—can be applied abroad to a greater or lesser degree. Many of them will be on a smaller scale and simpler in application, but properly adapted to the new overseas operation, they can be effective and can make it a worth-while venture.**

### Investment Guaranty Programs

One added protection for foreign investments that might be mentioned here is the I.C.A. Investment Guaranty Program under which American companies can be protected against currency inconvertibility and expropriation. The Government does not, of course, offer insurance against failure to make a profit; that is the problem of the individual company. Neither does the Government protect against devaluation of foreign currencies, nor against physical damage to the property from war, revolution, or other causes. It does, however, offer a practical insurance at a reasonable rate against two of the chief dangers which have sometimes troubled prospective American investors abroad—the risk of being unable to get their money out at any price because of exchange restrictions, and the risk of loss resulting from their investments being taken over by foreign governments. This insurance is not available on existing investment, but it is open on new additions to established investment as well as funds being put into new enterprises abroad. It also applies whether the investment is made in cash, materials and equipment, patents, processes and techniques, or services. There are about fifty-six countries and their dependent overseas territories participating in this program, and such insurance is worth investigating if one contemplates making new investments overseas.

The Godfrey L. Cabot Company, Boston, Massachusetts, was the first to take a guaranty of this sort; it covered its investment in a new carbon black plant in Great Britain.

**Tax Advice Essential**

**If one is going to expand abroad through branch plants, subsidiary companies, Western Hemisphere corporations, or in any other way, one should work closely with a capable tax expert who specializes in this field, for he can not only keep one out of trouble but also can save his client money in the long run.**

In April of this year, the Ford Motor Company covered itself against loss to the extent of $8,314,836 in its investment in the Ford-Werke A/G, Cologne, a subsidiary in West Germany.

### "Profit Sanctuary"

If a company's combined income from various foreign sources is sufficient to warrant it, the company may want to consider setting up a "profit sanctuary" in some suitable foreign country. A rapidly increasing number of American and European firms are setting up holding companies abroad to accumulate earnings on overseas operations, collect royalties and management fees that would otherwise be taxable to the parent company. These sanctuaries have been established in such countries as Canada, Switzerland, Bermuda, Panama, Venezuela, Uruguay, Monaco, Liberia, Luxemburg, and Liechtenstein. Earnings of a holding company so set up are free from risks of devaluation or inconvertibility in most, if not in all, these sanctuaries because the funds are usually kept on deposit in American banks but in the name of a foreign bank or other legal entity. Payment may be made to the holding company through the clearing agreements that the profit sanctuary has with soft or semisoft currency countries. Thus, for example, earnings in lire in Italy might be transferred to Switzerland, a hard-currency country, and held there pending reinvestment in some other country where expansion is desired. Profits from royalties or earnings in one foreign country thus can be utilized for expansion in another without transferring them to the United States with the consequent 52 per cent tax rate on earned income. This arrangement is merely a device to defer paying taxes on earnings overseas until they are actually transferred to the parent company here, and it has many advantages for American companies doing a large foreign business. When the time comes for shareholders of the parent company to get dividends from these constructive moves, the company and its shareholders will pay taxes made even greater by their overseas expansion program. In order to meet foreign competition, one must be alert and use every possible legal method to expand and to serve more people who want American products.

### Soviet Trade Threat

One final point of concern is the new Soviet change in policy. In time and in certain areas this may become an increasing threat to United States foreign relations and to its way of doing business. The Communists are now starting a new trade push, particularly in the Middle East, and in Southeast Asia. Already there is evidence that the Communist nations are taking supplies and raw materials in return for heavy equipment and dumping these materials on the world market. If this program is accelerated, it will affect services and products that the United States can supply.

### Businessmen as Diplomats

Most branches or subsidiary companies of American manufacturers have become the best possible example of democratic free enterprise in action. In Latin America, for example, American manufacturing companies have built many beautiful modern plants; Sears Roebuck Company has introduced modern retail merchandising methods and have taught many local manufacturers how to produce the many articles they need. These American companies pay millions of dollars each year in local taxes, they increase employment, and many of them contribute to substantial savings in foreign exchange and in the development of local markets. American pharmaceutical companies have provided many of the much needed new drugs and medicines for better health of the people. All these companies have stimulated new business, provided new products and services, and have made substantial contributions to an improved standard of living.

Equally important is the fact that American businessmen living abroad as "shirtsleeve diplomats" have established good working relationships between the people of these countries and the people of the United States.

Opportunities exist and will grow with each new contribution that American business makes to a nation's development. To maintain and develop an enviable position in world markets requires good planning, foresight, confidence, faith, and courage, and Americans have never lacked any of these attributes.

The functions of business management, venturing and risk-taking for profit, are more widely understood today than at any time in the past.

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*Presented at A.I.Ch.E. meeting, New Orleans, Louisiana.*

# The influence of EUROPEAN KNOW-HOW on American chemical industry

*A. H. Schutte* | The Lummus Company, New York.

If those products which were first manufactured commercially in European countries were eliminated from the present-day industrial scene in the United States, there would be many important gaps. To name just a few: there would be no rayon, no isooctane by alkylation, no polyethylene, no butadiene-styrene or acrylonitrile rubbers, no synthetic ammonia or urea, no isocyanates or polyurethanes. One could continue the list with pharmaceuticals and dyestuffs, new techniques of steel manufacture, metal-rolling methods.

One can safely predict that many new materials will come from people whose engineering, chemistry, and technology first perfected the gas turbine and the long-range rocket during the war. Those likely to regard European developments as overtheoretical need look only at Holland's comeback since 1945. They should also consider the case of West Germany, approximately the size of England and dependent on imports for half its food, and prostrate after the war. Its industry was destroyed or dismantled, its transportation systems divided, and even civilian housing seemed impossible to reconstruct. The social and industrial recovery of West Germany in the brief period since 1948 has been termed miraculous by the United States administrators who have witnessed it while taking into full consideration the 1.6 billions poured into it by the United States.

### Statistics of Chemical Production

**In the three-year period 1951 to 1954, chemical production has increased 18% in France; 27% in the United Kingdom; 48% in West Germany; and 56% in Italy. The corresponding figure for the United States is lower. The increase in organic chemicals has been even greater than for inorganic, with methanol, phenol, and acetone the leaders. Chemical industry in the United States now adds about nine billion dollars annually to the value of its raw materials. In Europe the corresponding added value is about five to six billion. New capital investment per unit of value added is about the same in both regions. Manpower requirements are somewhat more in Europe, but this fact is largely due to the greater part played by petrochemicals in this country. Large companies in Europe often devote 5% or more of their turnover to applied research.**

### Contrasting Picture—Europe

#### YESTERDAY

When American engineers were building and starting up plants in Europe twenty years ago, they felt that they were going back a decade in engineering techniques. Machinery and equipment were frequently unreliable, tailor-made, and difficult to maintain. Locally developed control devices were largely inoperable. It was not unusual to see a complicated cyclic process operated by a harried worker at the command of a timing bell. There was little or no communication between the man who worked out the chemistry of a process in glassware and the man who had to design the complex equipment to make it work on a plant scale.

#### TODAY

Today things are quite different. One sees beautiful pilot plants, complete with automatic instrumentation. Many old production units have been patched up, but the new ones are as modern as one could wish. Europe is training chemical engineers, in the American definition, and these men are teaming up with specialists in many fields to develop the processes and tools of a new industrial age in their respective countries.

### Europe and the United States

The economy of Europe is quite different from that of the United States, reflecting the completely different natural resources and transportation distances. In applying United States processes in Europe, it has often been found that the optimum plant design in our country is prohibitive in Europe. For example, it is conventional practice in the United States to remove acid gases by amine solution scrubbing. In many parts of Europe, however, the cost of heat for regeneration of the spent amine solution is prohibitive. Relatively cheap electric power dictates the use of water scrubbing in spite of the greatly increased circulation requirement. There are some profitable industrial operations on the European side of the water that actually show negative economics over here. Production of ethylene from acetylene is an example which shows the effect of power cost vs. expensive hydrocarbon raw materials.

The importing or exporting of process and technical know-how involves much more than a licensing agreement between the proprietor of the process and the potential user. It means that (1) the engineering must be translated into the units of the new country, (2) the basic design must be modified to fit into the new economy, and (3) the mechanical equipment should be obtained locally in order to fit manufacturing and safety specifications and to permit ready servicing. These changes must be effected, but no liberties can be taken with the fundamental process variables, which are often not too obvious. There have been plants on both sides of the Atlantic which are unpleasant reminders of failure in some of these facets of translation. Obviously, the translation cannot be too literal. There is no substitute for a working cooperation between the two groups of engineers and the mutual understanding so generated. (The paste pot and pair of shears approach seldom works.)

The soundest approach usually follows about this pattern, taken from a recent case. The foreign process and plant are studied by engineers familiar with both United States and European practice and equipment. A preliminary process design is blocked out by the insertion of the particular United States conditions of raw materials, utilities, climate, product specifications, etc., which will prevail for the proposed project. Frequently, at this point, it is necessary to run semiplant-scale checks on some steps of the process to determine whether readily available United States equipment can be made to perform special and unusual functions. When the equipment for each of the unit operations has been specified, the design is thoroughly checked with the engineers and operators of the European company.

The next step is to make an accurate cost estimate of the plant and a check on the over-all economics compared with other processes. These studies usually

will place the novel features in a true perspective and indicate modifications in the basic design. Then in a position to finalize the design, one proceeds with the detailing, specification, and layout of all the material. Training of operators at the European plant may be carried out during the final engineering and construction phases and the task of engineering translation is thus completed.

#### To Meet World Competition

Europe is faced with the problem of changing from a coal economy to other sources of energy and chemical raw material. The basic building block for synthesis has been acetylene, which will continue as a vital product increasingly from hydrocarbons rather than from calcium carbide. Developments in acetylene chemistry are coming and will be of greater and greater interest to this country. But Europe will also make giant strides in the production of ethylene and the higher olefins to meet world competition and the changing raw material situation.

#### Phenomenal Rise in Plastics

The rapid rise of the plastics industry in Western Europe will be accelerated by new products developed by research. Polyethylene has already made news on both sides of the Atlantic. Originally, a high-pressure process was developed in England and was licensed by several American companies; then, after some years, German research produced a new low-pressure technique which was developed to the commercial stage on both sides of the Atlantic. Simultaneously, at least one American low-pressure process appeared. This is typical of the type of competition which stimulates progress in world chemical industry. Now polypropylene from Italian research promises to be an important low-cost plastic and fiber. New polystyrenes will offer unique properties, adding to the range of plastic materials and opening up new industrial and consumer applications. These developments may add up to a revolution in plastics brought about by teamwork between European and U. S. research.

The policy of the United States is to help underdeveloped countries to increase their food supply, raise their low standard of living, and create an internal market for the requirements of a fuller life. American chemical industry will realize that the problems of these countries are much more like those of Europe than like those of its own country. Then, in the underdeveloped places like some parts of South America rich in natural resources but lagging in development, the United States must be ready to meet competition in providing the facilities which are sure to be constructed in these countries, or better yet, to cooperate with those who have already faced these problems.

In the future, the automotive industry in the United States will switch from the piston engine to the gas turbine; the outcome of this change-over will be a revolution in the petroleum and chemical industries. The refiner will forget about the octane race. He will have to produce the maximum amount of paraffinic middle distillates from a barrel of crude. There will be diminished need for tetraethyl lead. Antifreeze and the lubricating oil and additives business will be smaller in volume and newly specialized. A need will exist for techniques, among them cheap methods for low-pressure hydrogenation. United States producers can develop their own methods or accept those already worked out abroad.

Two primary choices await a United States company wishing to produce a new material which is already made abroad and perhaps also in this country by a competitor who has no incentive to license. These alternatives are: to develop its own process through the laboratory, pilot plant, and commercial stages, or to license from abroad and carefully translate the engineering and know-how to its own situation. If the company chooses the former alternative, it should evaluate the development expense—a difficult thing to do—and it should also estimate the time delay in getting the plant completed and the money value of this delay as lost production. Then the company can weigh one alternative against the other and make a judgment on the amount it is justified in spending for foreign know-how. Other factors, such as the patent situation, will be considered also. It should be borne in mind too that development and pilot plant work can be done in Europe much more cheaply than in the United States.

The maximum progress will be made by developing, certainly, but also by adopting what has already been done and adapting it to one's needs by exchanging experience and intelligently applying it to the job in hand.

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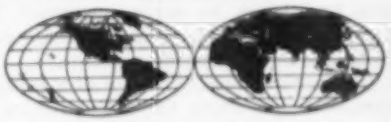
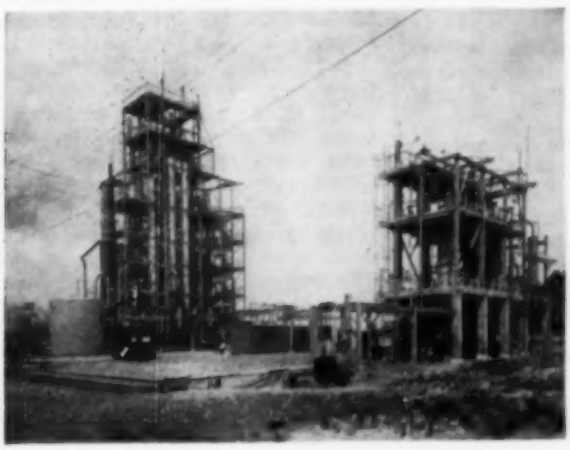
*Presented at A.I.Ch.E. meeting, New Orleans, Louisiana.*

## foreign chemical developments



### and their effect on the U. S. chemical industry

Air Reduction Chemical Company vinyl acetate monomer plant, Calvert City, Ky., based on Wacker process (Germany) adapted to U. S. practice.



General Aniline & Film Corporation's high-pressure acetylene derivatives plant at Calvert City, Ky., based on German "Reppe chemistry."

A new process employs high velocity impact disintegration of sugar beets for the direct preparation of juice and of pulp from which the sugar is washed. This process contrasts with the countercurrent diffusion process which has been in wide use for almost a century.

Equipment hinges on the use of a feeding mechanism of special design where the beet particles are fluidized in steam. The particles are accelerated to a high velocity with a steam jet ejector and then are impacted against the surface of a stationary impingement baffle where the beet cells are ruptured.

Sugar recoveries of about 99 per cent have been obtained when use is made of a relative centrifugal force of 666 gravities for separation of juice and wash from the pulp. Except for filtration rate, the quality of thin juice prepared from pulp juice compared favorably with that of thin juice prepared from diffusion juice.

Main advantages of the equipment are simple design, continuity of operation, and small size for comparatively high capacity. Although further study is required to improve efficiency, the feasibility of the process is believed to have been demonstrated.

# Recovery of juice from

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The more critical requirements for the successful development of a cell-rupture process for sugar beets can be listed as follows:

1. The quality of the juice should not be decreased.
2. The cell structure of the beet should be ruptured as completely as possible, without, however, producing a great amount of fines. This last point is of importance for easy centrifuging or filtering.
3. The equipment should be simple in design, continuous in operation, and should have a relatively small size with a high processing capacity.
4. For the process to be competitive with the diffusion process, the sugar lost in the pulp cake should be about 1% of the sugar in the beet at drafts * of 130% or lower.
5. The equipment used for the separation of the juice should be continuous and inexpensive and should enable a uniform washing and a good dewatering of the pulp cake.
6. The drying of the pulp should not require any drastic changes in existing dryers.
7. The steam and mechanical energy consumption should be within reasonable limits and should correspond to conditions existing in an average sugar factory.

In preliminary studies of this problem, rupturing of the cell structure of the beet was effected mainly by a combination of two factors: an increase of pressure inside the cell and a sudden change of momentum of beet particles accelerated to a high velocity. For this purpose the beet cossettes (chips) were first preheated for a short time with saturated steam at atmospheric pressure, then the steam pressure was suddenly increased and the cossettes blown out into atmospheric pressure. The fast moving cossettes were then allowed to strike an impingement baffle where they disintegrated to pulp. Although this method gave satisfactory results as far as quality of the juice was concerned, regulation of process conditions such as time and temperature was difficult and dilution of juice was unavoidable. Further study of this problem has shown that by using higher velocities and more efficient impact surfaces a high degree of disintegration can be achieved by a sudden change of momentum alone. This principle, being simpler and more adaptable to continuous operation, was used as a basis for the design of a continuous disintegrator. A discussion of the disintegrating equipment as well as a general outline of the proposed method follows.

### Outline of Process

The flow sheet given in Figure 1 presents schematically the proposed method of raw juice production. Cossettes or beet particles of other shape are introduced into the feeder hopper. The cossettes are removed from the hopper by the impeller of the air lock. A part of the low-pressure steam leaving the separator is recycled into the lower part of the air lock to fluidize the cossettes. The fluidized mixture of cossettes and exhaust steam enters the ejector chamber. In the ejector chamber high-pressure steam issuing from the nozzle transfers some of its momentum to the mixture of vapor and cossettes. The cossettes are accelerated to a high velocity and allowed to strike an impact surface arranged in the separator. This impact causes rupture of the beet cells. The resulting pulp is then removed from the separator either by keeping the pressure in the separator slightly

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Additional material is on file (Document 4976) with A.D.I. Auxiliary Publications Project, Library of Congress, Washington, D. C. Photostats and microfilm obtainable by remitting $2.50 and $1.75, respectively.

* $\text{draft} = \frac{\text{weight of diffusion juice} \times 100}{\text{weight of beets}}$

# sugar beets by rupture of the beet cells

higher than atmospheric or by means of a suitable revolving scraper. This separation should be accomplished as quickly as possible to minimize condensation of steam on the pulp and resultant dilution of the juice. The expanded steam is partially recycled to the airlock and the rest used for juice heaters, etc. The juice is separated from the pulp in a centrifuge, filter, or other separating equipment by washing and the exhausted concentrated pulp is sent to a dryer.

**Experimental Equipment**

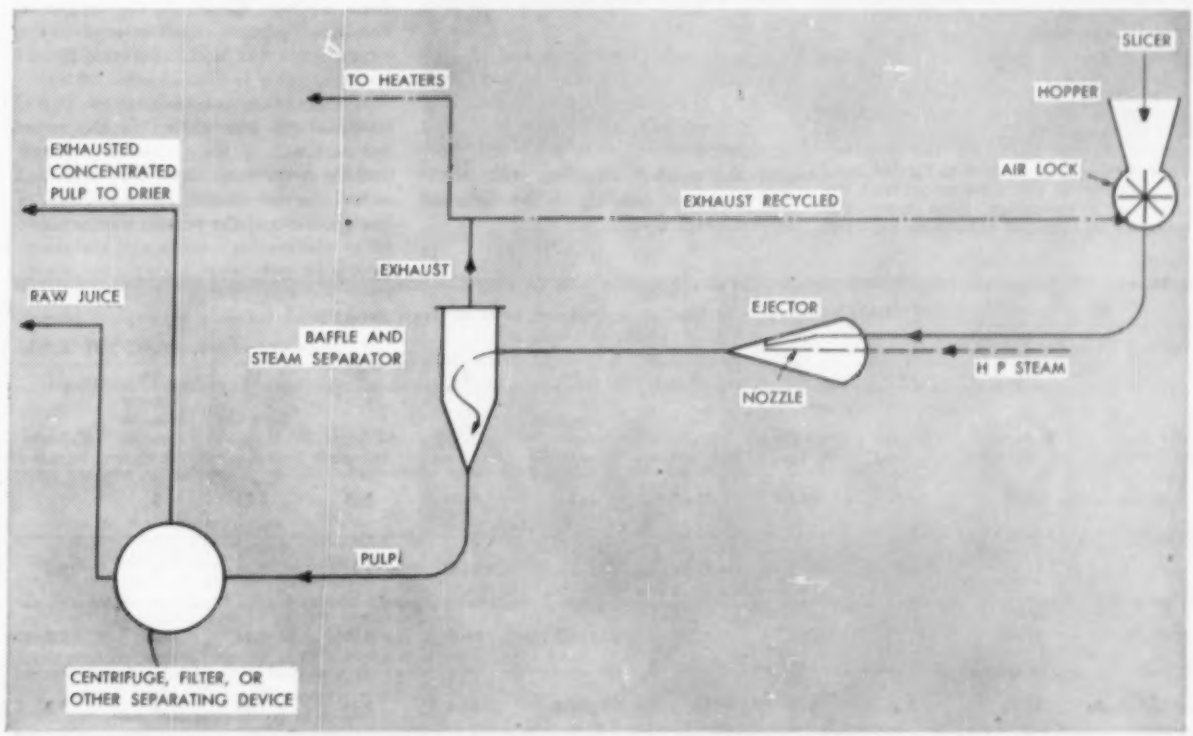
The disintegrator assembly shown in Figures 2, 3, and 4 consists of the following main parts: feeder, ejector, acceleration pipe, and impingement baffle.

**FEEDER**

The function of the feeder (Figures 2 and 5) is to obtain a constant and uniform particle flow rate so that the ejector can be uniformly and continuously charged without appreciable flow pulsation.

The feeder, Figure 2, consists of three parts. The upper part, or preliminary feeder—12 in. in diam.—can accommodate about 25 lb. of cossettes. The bottom of this preliminary feeder consists of a system of two cones. The outside cone, *b*, is made of stainless steel screen to allow the passage of condensate in the case of steam pretreatment. The closing cone, *a*, is fixed on the stirrer rod, *c*, which makes a reciprocating motion up and down. The length of the stroke, the number of strokes per minute as well as the position of the cone, *a*, on the stirrer rod can be adjusted. The reciprocating motion of the cone loosens the mass of cossettes and allows the particles to fall through the central

Fig. 1. General flow sheet of the proposed method.



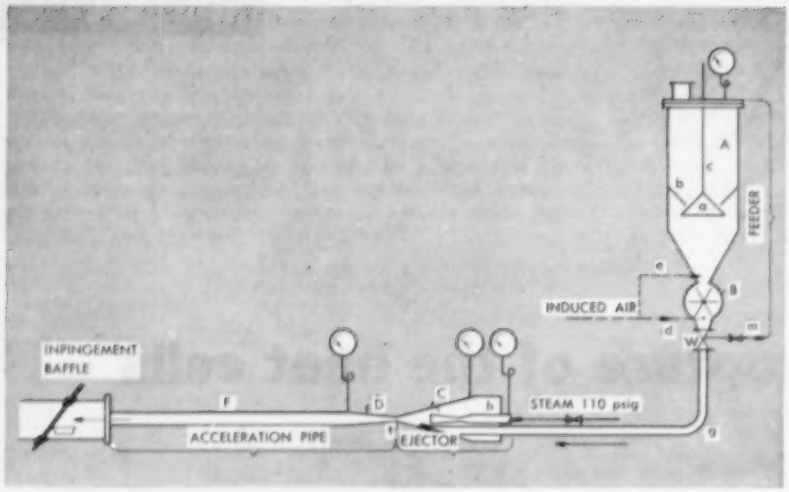



Fig. 2. Disintegrator assembly.

cylindrical section of the preliminary feeder down to the conical bottom.

A metered amount of air is introduced (*e*, Figure 2) at the top of the rotary feeder to prevent choking at its relatively small inlet. From there the particles are picked up by the blades of the rotary feeder and dropped into the stream of air (or steam) introduced through the front plate of the casing (Figure 5). As a result of the vacuum existing in the ejector chamber *C*, the particles are carried into the ejector chamber by the stream of air or steam.

In all experiments air was used instead of steam to convey the cossettes to the ejector. The main reason was the inadequate air-locking property of the rotary feeder used. If steam had been used and the pressure in the rotary feeder increased slightly above atmospheric, leakage of steam would have occurred upwards to the cossettes, resulting in condensation and in a change of process conditions.

One of the chief requirements for good operation of the feeder is the production of a uniform flow. In small-scale equipment as used in this work the frequency of the discharge pulsations at the 160 rev./min. velocity of the six-compartment impeller was 16 pulses/sec. Even though this frequency is small, it cannot be neglected when one considers the high velocity of the particles, especially at the outlet of the acceleration pipe. It is believed that further improvement in the uniformity of the flow would considerably affect the over-all steam economy of a full-scale system.

The cossette-air mixture leaving the rotary feeder was introduced into the ejector chamber through a 1-in. standard brass pipe 90 in. long.

### EJECTOR

In all experiments dry saturated steam of 110 lb./sq.in.gauge was used for acceleration of the cossettes. Steam flow rate was 3.53 lb./min. The steam nozzle (Figure 2, *h*) was of convergent-divergent type with a 0.200-in. throat diam. and 0.317-in. exit diam.

Introduction of cossettes and air into the chamber would ideally be axial with the flow of the accelerating steam. The solution used for the small-scale unit introduced the cossette inlet pipe deep into the ejector chamber with slight flattening and bending in the direction of the steam flow.

### ACCELERATION PIPE

The acceleration pipe provides a path for acceleration of cossettes. Two different pipes were used. One of these was a ¾-in. standard brass pipe 37-5/16-in. long which was connected with the ejector chamber by a short diffuser *D* (Figure 2). The total angle of convergence of the entrance to the diffuser throat was 25 deg. and the diameter of the diffuser throat was 0.625 in. The other was a 0.5-in. standard brass pipe 16⅝ in. long which was connected directly (without diffuser) with the chamber.

### IMPINGEMENT BAFFLE

The impingement baffle provides an efficient impact surface for the cossettes. An important requirement for good operation of an impact surface is easy and quick removal of the pulp formed, as accumulation "insulates" the impact surface and decreases efficiency. In general, a baffle of low efficiency will require a higher particle velocity and therefore greater steam consumption. Another factor considered was that the impact surface might benefit by exhibiting a cutting or abrasive action on the particles to assist in their disintegration. Several types of surfaces, both flat and cylindrical, were investigated and subsequently are discussed.

#### Experimental Technique

Given the small diameter of the diffuser throat (0.625-in.), the length of the thin V-shaped cossettes used in the experiments was held to between ¼ and ½ in.

A known amount of cossettes (6,000 to 7,000 g.) was placed in the upper compartment of the preliminary feeder and the cover was closed. Dry saturated steam was introduced into the nozzle of the ejector and the pressure adjusted to

Table 1.—Influence of Type of Impingement Baffle on Sugar Recovery

Flow Rate of Steam, 3.53 lb./min. Flow Rate of Induced Air, 2.41 lb./min.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Run | Type of baffle | % Sugar in cossettes | Dilution %/beet | Wash water %/beet | Draft % by weight | Corrected draft % by weight | Cake %/beet | % Sugar in cake | Sugar lost in cake %/beet | Vacuum in ejector chamber in. Hg. | Capacity lb./min. |
| I | Double screen | 17.47 | 11.3 | 55.5 | 136.7 | 125.4 | 30.1 | 0.69 | 0.21 | 5 | 10.6 |
| | Cylindrical | 17.47 | 10.0 | 53.2 | 126.4 | 116.4 | 36.8 | 2.34 | 0.86 | 4 | 10.6 |
| II | Double screen | 17.70 | 11.2 | 55.3 | 135.9 | 124.7 | 30.5 | 0.90 | 0.27 | 5 | 9.8 |
| | Flat baffle | 17.70 | 8.3 | 53.8 | 127.6 | 119.3 | 34.4 | 3.61 | 1.24 | 6 | 9.2 |

110 lb./sq.in. gauge. Air at 2.41 lb./min. was introduced into the rotary feeder, the speed of which was adjusted to 160 rev./min. By starting the reciprocating stirrer, the disintegrator assembly was put into operation. The pulp formed was collected in a container placed under the baffle. The duration of the experiment varied between 30 and 60 sec. depending on the capacity used. A well-mixed sample of pulp was collected in a closed jar, cooled, and used for the recovery test.

Juice was separated from the pulp at a relative centrifugal force of 666 gravities.

The draft, the amount of wash water used, and the amount of cake were determined by direct weighing and the corresponding values expressed in per cent per beet. When complete comparative tests were made in which the qualities of thin juices were compared, the raw pulp juice and the diffusion juice (prepared from the same sample of cossettes) were subjected to the same purification process, including hot progressive preliming, main liming, first and second carbonation, boiling and filtration.

#### Experimental Results

Three different types of impingement baffle were used:

**The double-screen baffle consisted of two 9-mesh brass screens (0.045-in. wire) placed one on the other so that the openings of the screens partially overlapped. The screen assembly was set at an angle of 45 deg. to the direction of flow.**

**The flat baffle consisted of a steel plate machined with fine grooves in a diamond pattern, set at an angle of 45 deg. to the direction of flow.**

**The cylindrical baffle consisted of a bronze cylinder with vertical grooves along half of its inside surface. The cossettes were introduced tangentially in a direction perpendicular to the grooves and allowed to travel along the grooved portion. A helical partition arranged inside directed the pulp to a conical outlet on the base of the cylinder.**

Results of studies comparing impingement surfaces are given in Table 1. Data on run 1 show that the double-screen baffle is decidedly better than the cylindrical type.

Although the results shown in Table 1 do not favor the use of the cylindrical baffle, it is possible that by decreasing the area of the grooved surface the efficiency of this baffle could be increased. It is believed that this change in design would facilitate the passage of the pulp and keep the grooved portion cleaner and thereby make it more efficient. The advantage of this type of baffle is that, if successfully developed, it would also serve as a steam separator.

Table 1, run 2, shows that the double-screen baffle is also better than the flat plate baffle. It is possible that the better efficiency of the screen baffle may be due to its self-cleaning action which decreases the "insulating" effect.

#### Quality of Pulp Juice Compared With Diffusion Juice

In order to obtain a better comparison of the qualities of juices prepared by these two different methods, three complete experimental runs were carried out in which both raw juices were submitted to the usual purification process (previously described) and the resultant thin juices analyzed.

Table 2, in which the results of these experiments are presented, is divided into two parts: part 1 gives data concerning production of the pulp and sugar recovery, and part 2 presents the characteristics of juices prepared in each run from the same lot of beets. It

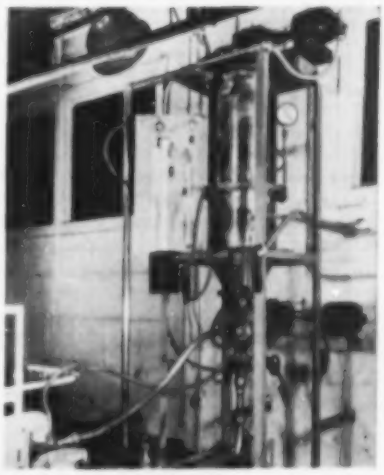


Fig. 5. Feeder.

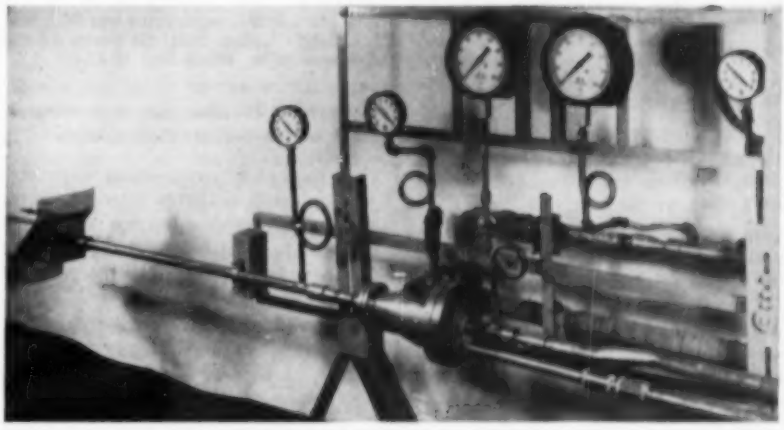


Fig. 3. Disintegrator without feeder.

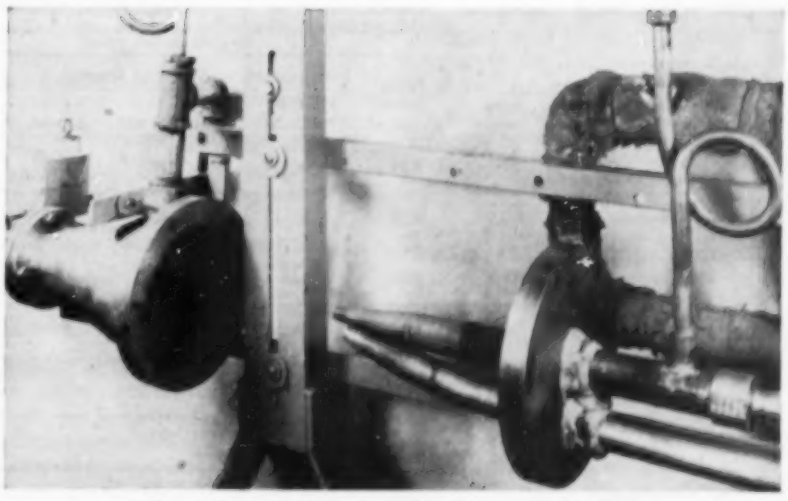


Fig. 4. Ejector chamber with nozzle and inlet pipe withdrawn.

**Table 2 (Part 1).—Juice Prepared from Pulp vs. Diffusion Juice**

Flow Rate of Steam, 3.53 lb./min. — Flow Rate of Induced Air, 2.41 lb./min.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Run | Process | % Sugar in cossettes | Temp. of pulp ° C. | Dilution %/beet | Wash water %/beet | Draft % by weight | Corrected draft % by weight | Cake % of beet | % Sugar in cake | Sugar lost in cake % of beet | Avg. capacity lb./min. | Pressure in diffuser lb./sq.in.gauge | Pressure in ejector chamber in. Hg. | Pressure in rotary feeder in. Hg. | I.D. of pipe, in. |
| I | From pulp | 17.74 | 71 | 9.8 | 48.9 | 126.9 | 117.1 | 31.7 | 0.95 | 0.30 | 8.3 | ... | 1-2 (vac) | 1½ to 2½ | 0.625 |
| II | From pulp | 17.15 | 68 | 7.5 | 54.1 | 135.6 | 128.1 | 26.3 | 0.51 | 0.13 | 7.1 | ... | 2-3 (vac) | 1 to 2 | 0.625 |
| III | From pulp | 17.69 | 65 | 6.95 | 54.6 | 132.3 | 125.4 | 29.2 | 0.92 | 0.27 | 23 | 2-3 | 0 to 2 | .... | 0.822 |

appears that juice obtained directly from pulp has a tendency to give upon purification a juice of better quality than that prepared from diffusion juice. However, no definite answer can be given to this problem until a greater number of tests are made with different beet materials.

### Effect of Higher Centrifugal Force

The influence of centrifugal force on the completeness of sugar recovery was studied in an experiment carried out at 1,460 gravities.

In this experiment, setting of the baffle and acceleration pipe, and washing procedure were the same as in run 3, Table 2. The same beet material was used at a processing capacity of 18.9 lb./min. Following separation at 1,460 gravities, the amount of pulp cake was reduced from the usual value of about 30 to 21.4% per beet. With the use of a smaller amount of wash water (45% per beet) it was possible to decrease the sugar loss in cake to 0.14% per beet. Values of the actual and of the corrected drafts were 133 and 125% per beet, respectively. The apparent purity of the pulp juice in this experiment was 91.2, that is, slightly higher than the purity of the diffusion juice, which was 90.8.

### Influence of Chemical and Heat Pretreatment on Degree of Disintegration

A number of experiments were carried out with cossettes pretreated with milk of lime and aluminum sulfate, to find out to what extent changes in the hardness and brittleness of the particles affect their disintegration.

In no case was an improvement in the degree of the disintegration observed. On the contrary, cossettes pretreated with milk of lime gave poor disintegration, which resulted in greater amounts of pulp cake and higher sugar losses than when operation took place with fresh untreated cossettes. Similar results were obtained with cossettes steamed for a short time at atmospheric pressure.


### Acknowledgment

The work on removal of sugar from beets herein reported was done under contract with the Agricultural Research Service, U. S. Department of Agriculture, under the supervision of the Western Utilization Research Branch, Albany, California.


*Presented at A.I.Ch.E. meeting, Houston, Texas.*

**Table 2 (Part 2).—Juice Prepared from Pulp vs. Diffusion Juice**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Raw Juice | | 1st Carbonation Juice | | | | Thin Juice | | | |
| | | | | | Rate of filtration | | | | | | |
| Run | Process | purity (refr.) | Pectin (Silin) g./100 ml. | Alkalinity % CaO | 50 ml. | 100 ml. | 150 ml. | Purity (refr.) | —Log T at 560 mμ | Lime salts mg. CaO/ 100 Bx* | Sp. cond. at 18° C. and 5 Bx* mhos/cm. |
| I | From pulp | 89.9 | 0.24 | 0.06 | 56" | 3'0" | 7'32" | 93.9 | ..... | 28 | ..... |
| | Diffusion | 90.9 | 0.30 | 0.06 | 50" | 2'23" | 5'45" | 93.9 | ..... | 34 | ..... |
| II | From pulp | 89.7 | 0.28 | 0.066 | 49" | 2'31" | 6'08" | 94.0 | 0.002 | 22 | 0.00135 |
| | Diffusion | 90.2 | 0.29 | 0.06 | 41" | 2'04" | 5'38" | 93.4 | 0.036 | 41 | 0.00146 |
| III | From pulp | 90.2 | .... | 0.064 | ... | ..... | ..... | 94.0 | 0.008 | 26 | 0.00132 |
| | Diffusion | 90.2 | .... | 0.079 | ... | ..... | ..... | 93.3 | 0.044 | 21 | 0.00142 |

* Bx = Brix scale.

# Gas-liquid contacting with MULTIPLE MIXING TURBINES

Mixers for gas-liquid reactions are often equipped with multiple turbines on a single shaft. Studies show that dual and triple turbines may give larger or smaller mass transfer coefficients than single impellers. The effect of turbine spacing in 6-in. and 12-in. diam. tanks is reported for various levels of power input and gas flow rates. Coefficients were measured for the air oxidation of sodium sulfite solution in water.

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There are many operations requiring the contact of gases and liquids where the liquid is the major amount and the continuous phase. One simple method is to bubble the gas through the liquid; the gas can be introduced by sparge pipes at the bottom of the liquid. Mixing impellers of the turbine type are used frequently to increase the rate of mass transfer between the phases over that obtained without the use of the mixer.

## Mass Transfer

### RATE

In most gas-liquid mixing operations the object is to transfer material from one phase to the other. The mixer can affect the mass transfer rate in three ways: It can affect the concentration gradient and the driving force ($\Delta C$) by controlling the rate of distribution of the components; it can affect the interfacial area ($A$) by influencing the size of the gas bubbles and their retention time; and it can affect the mass transfer coefficient ($K$) in the *liquid* phase by the turbulence and flow produced in the liquid. The simple mass transfer rate equation:

$$w = KA\Delta C \qquad (1)$$

shows that the mass rate of transfer ($w$) is proportional to the interfacial area and the concentration driving force. The proportionality constant is the over-all mass transfer coefficient. It is usually more convenient to use $\Delta C$ for the concentration gradient in the body of one phase; if this is done, the coefficient will be based on that phase only. Hence, Equation (1) can be written

$$w = K_L A\Delta C \qquad (2)$$

where $K_L$ applies to the liquid phase mass transfer and hence the concentration gradient also applies to the liquid. Since it is difficult to determine the area $A$, the specific area per unit volume of liquid ($a$) can be used with the liquid volume ($V$); thus $aV = A$. By the substitution in Equation (2), the result is

$$w = K_L aV\Delta C \qquad (3)$$

The group $K_L a$ will be a function of gas dispersion, bubble size, and liquid phase turbulence, and can therefore be used as a measure of performance of a mixer.

The reciprocal of the over-all coefficient of mass transfer is equal to the sum of the reciprocals of the individual film resistances; accordingly, either the liquid- or gas-film coefficient may be used as a measure of the over-all rate of mass transfer. In this work it was more convenient to use the gas-film coefficient $K_G$; hence, $K_G a$ values have been calculated rather than $K_L a$ values for use as a measure of performance. The relation to be used is

$$w = K_G aV\Delta C \qquad (4)$$

### REACTION USED TO EVALUATE

The object of the experimentation was to measure mass transfer rates between a gas and a liquid as a function

of mixing; the actual transfer system studied was chosen for its convenience of analysis and control. The reaction used was the oxidation of sodium sulfite solution by oxygen absorption from air. This system has been used before and details for its use and accuracy have been described (*1, 4*). The advantages of the system are the ease of analysis, and the fact that the oxidation of the sulfite is independent of sulfite and sulfate concentration over wide limits of concentration.

The rate of oxygen absorption from the air bubbles was measured by the rate of oxidation of the sodium sulfite. Liquid samples were taken at frequent intervals in order that the rate of oxidation of the sulfite could be determined. Since the amount of transfer of oxygen through the air to the interface must be equal to the oxygen absorbed by the sulfite, the mass transfer coefficient was calculated, for convenience, as $K_g a$, even though the fluid motion and turbulence in the liquid plays the major role in controlling the over-all rate of oxygen transfer.

#### One or More Turbines

Data have been reported on the effect of mixing impellers for various gas-liquid contacting reactions (*1, 3, 9*). In this work, one, two, and three turbines on one shaft were used, with air injected below the lowest impeller. Large commercial fermentation and other operations may use relatively deep cylindrical reaction vessels, for example, 8-ft. diam. and 20 ft. high. In such vessels the question arises as to the best way to apply the power for mixing—whether to use one, two, or more turbines on the same drive shaft and how to space them.

#### Experimental Equipment

All data were obtained for cylindrical tanks, vertical axis, and the vertical mixer shaft centered on the axis of the tank. Four baffles, each 1/12 tank diam., were placed at 90-degree intervals at the side of the tanks.

Figure 2 is a diagram showing the arrangement of turbines, tank, and liquid. (The notation used for dimensions is given in the notation section.) The height of the lower turbine above the flat bottom of the tank is indicated by $C$ and is measured to the flat disk of the turbine.

Tank diameters of 6 and 12 in. were used. The different positions of the turbines are shown in Table 1. Air was introduced by means of an open pipe directly beneath the center of the lower turbine in all runs in the 6-in. diam. tank. In the 12-in. tank, air was brought in through a sparge ring, the diameter of which was equal to that of the turbine and was placed 1 in. below the lower turbine. There is no significant difference in performance due to the different air-entrance techniques in the range of air flow and power used.

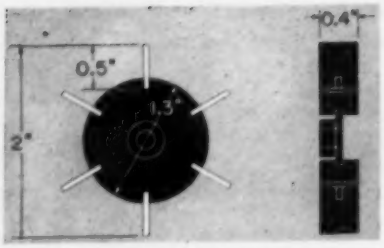



Fig. 1. Turbine dimensions.

Power input at the turbine was measured by calculations from speed and torque readings. The speed of rotation of the shaft was measured by an electric tachometer attached to the motor shaft. Speed was varied by means of a Variac voltage control. Torque was measured by weighing the force exerted through the radius of a disk on which the driving motor was mounted. The motor and torque arm disk were free to turn but were held in position by a string attached through suitable pulleys to a weighing scale (*2*).

Air was provided from a compressor and measured by a calibrated rotameter after passing through pressure controlling valves.

#### Flow Patterns

The flow pattern resulting from a single flat-blade turbine, Figure 1, is essentially as shown in Figure 3; this is a flow pattern conducive to good mixing (*6, 7*).

When two turbines are on one shaft and are sufficiently far apart, a flow pattern will result approximating that shown in Figure 4. Each turbine operates essentially independent of the other turbine. Each turbine has radial flow characteristics and each produces a flow like that in Figure 3. When two turbines are closer together, there is interaction between the flows and peculiar and unexpected flow patterns will result. For example, Figure 4B shows a peculiar flow pattern wherein the lower turbine appears to give axial flow in that it drives liquid through the blades toward the bottom of the tank. The upper turbine gives radial flow and acts more nearly like a single turbine.

A dotted area is shown on Figure 4B to represent the area photographed and reproduced in Figure 5. This photograph was made by a technique used to trace the flow patterns of small bubbles and drops in a mixing tank (*8*). The area of the photograph covers part of two turbines and extends from the center of the tank to the wall. The white traces made by the drops in the fluid show clearly the flow pattern diagrammed in 4B. In other photographs taken with different turbine spacing and with different turbine diameter, tank diameter ratios have shown many unexpected results. In some positions the interaction between the turbines is such as to cause the lower turbine to give an upward axial flow and the upper turbine to give a downward axial flow with the result that radial flow occurs toward the wall at a point midway between the two turbines.

From flow pattern studies it would be expected that various reaction rate results might easily accrue from the effect of turbine spacing.

It has been found that the power required to turn the turbines in position 4A is higher than that required to turn them at the same speed in position 4B. If comparisons are made between 4A and 4B on the basis of the same power input, it is clear that different speeds of rotation will be used in the two cases. Different rotational speeds may have a large effect on gas distribution and bubble size and total gas-liquid interfacial area.

#### Experimental Results

Typical experimental and computed data are shown in Table 1 for the various conditions used. In all, more than 130 runs were used in the comparisons to follow (*2*).

Tank diameters were 6 in. and 12 in. Liquid depth is shown in column 4. Turbine diameter to tank diameter ratio was held constant at one third as shown by columns 2 and 3. Number of turbines is shown in column 5. Their position above the bottom of the tank is given in columns 6, 7, and 8. The spacing between turbines is the difference between columns 6 and 7 and columns 7 and 8. Speed of rotation was varied as in column 9. Power was computed from torque measurements. Horsepower per gallon, in column 11, shows the level of power input per unit volume so that comparisons between different sized dimensionally similar systems can easily be made. Air flow was measured as cu.ft./sec. at 1 atm. and 70° F.; it was divided by the cross-sectional area of the tank to give the superficial vertical linear velocity (tabulated in column 12). The absorption coefficient $K_g a$, in the units lb.moles/(hr.)(cu.ft.)(atm.), multiplied by 100 is given in column 13.

#### SIX-INCH DIAMETER TANK

All the runs in the 6-in. diam. tank were made with a 28-in. ungassed liquid depth. Three different levels of power input were used. The intermediate power level was twice the low value and the highest power was four times the low value. Three different air flows were used at each power level. The intermediate air flow was 68% greater and the high air flow was 130% greater than the low air flow. Absorption coefficients were determined at each condition for a single turbine. For dual turbines the coefficients were determined for many spacings, S, between the lower and upper turbines.

Figure 6 shows curves for different

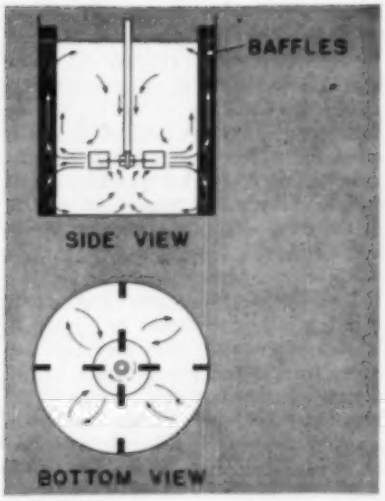



Fig. 3. Flow pattern for a single turbine.

power levels and different air flow rates. The absorption coefficient is shown as ordinate, and the abscissa is given as the ratio of spacing to turbine diameter. The position marked $S/D = 0$ on the abscissa is for single turbine operation. All other points on the curves are for dual turbine operation. Each curve represents the absorption coefficient for constant power input and constant air flow rate. The curves are labeled to show the power imposed and air flow used: 1P refers to the lowest power (0.9 hp./1,000 gal.). 2P and 4P show power levels of two and four times the lowest power. 1A represents an air flow of 0.025 ft./sec., 1.7A and 2.3A represent air flows of 1.7 and 2.3 times the low flow of 1A.

It is clear from Figure 6 that under some conditions dual turbines give better results at constant power input than

Fig. 5. Trace photograph of dual turbine flow showing interaction. Spacing—1.5 turbine diameters.

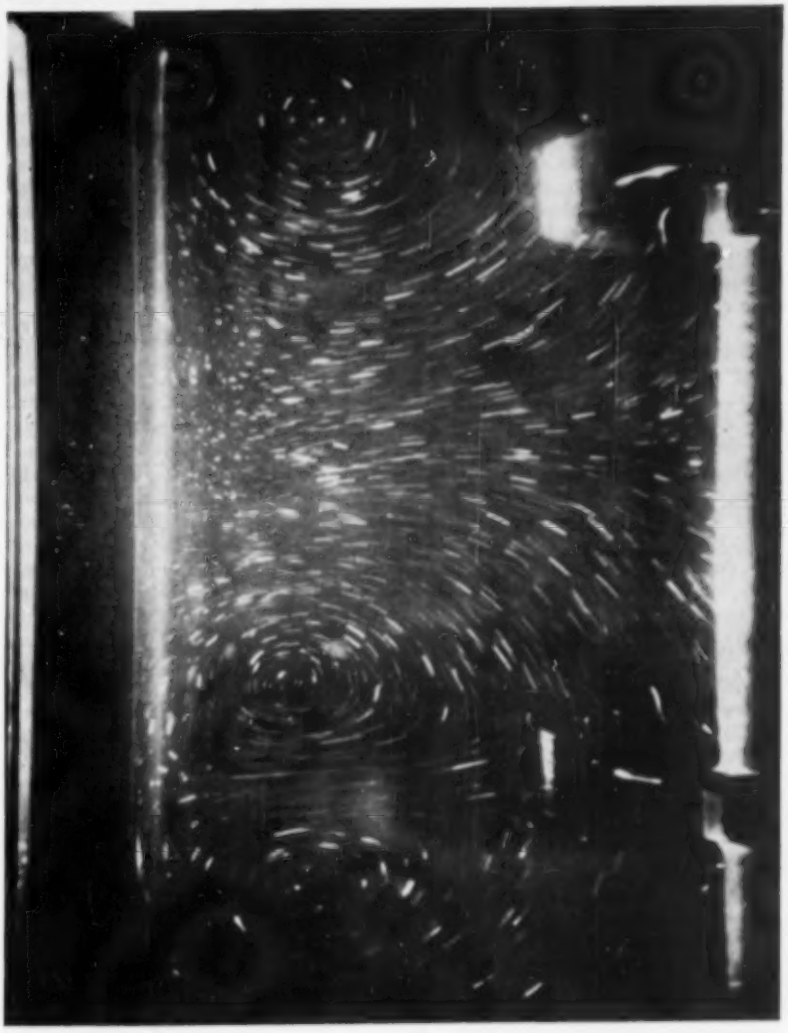


Fig. 2. Cylindrical mixing tank, four baffles each T/12 wide.

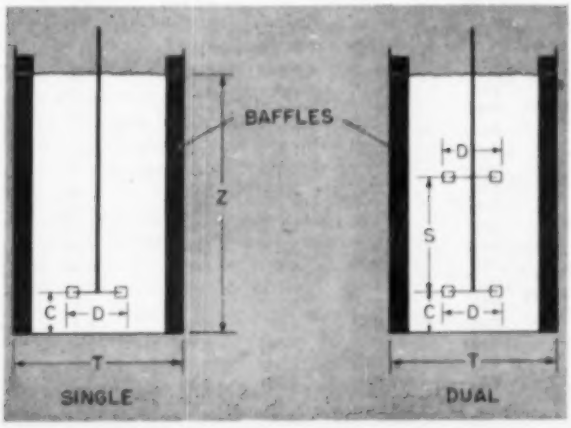
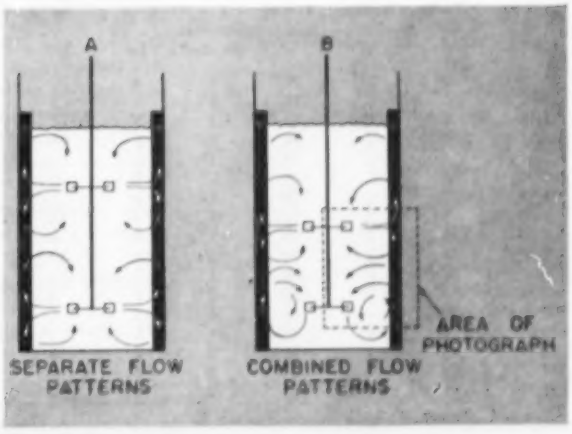



Fig. 4. Flow patterns—dual turbines.



single turbines do. It is also evident that under some conditions dual turbines give poorer results for the same power. The curves all appear to be irregular and many check runs were made to be sure that the shape of a curve was actually due to turbine positions and not due to a scattering of data. It is believed that the dips and rises in the curves are related to the differences in flow pattern and the differences in rotational speed resulting therefrom. Data (curve 1P1A) show that at low levels of power input, 0.9 hp./1,000 gal., dual turbines give either the same coefficient or a lower coefficient for each of the air rates used. Actually, there is only one rather critical position of spacing which will give coefficients equal to that for a single turbine. A summary of the data shows that the use of dual turbines at low power levels can decrease the mass transfer rate to as much as 50% of the single turbine value.

At twice the power input (curve 2P1A) the mass transfer coefficients for dual turbines varied between a 10% increase and a 30% decrease at all rates of gas flow. Again. the increase due to the dual turbines occurred at a relatively critical turbine spacing.

With the highest power inputs as shown in curves 4P1A, 4P1.7A and 4P2.3A, the use of dual turbines always resulted in equal or in a greater absorption coefficient than that obtained for a single turbine. Depending on the gas flow rate, the position of maximum coefficient occurred at different turbine spacings. The maximum increase with the use of dual turbines was found to be 25% above that for a single turbine.

In all cases it was found that the absorption coefficients reached their highest peaks for relatively large turbine spacings, $S/D$ from 3 to 7. As the turbine spacing was increased further, the absorption coefficients fell below their maximum.

Figure 7 summarizes the many runs and experimental conditions. For three different levels of power (horsepower during aeration per volume of ungassed liquid) mass transfer rates may be less, equal to, or greater than for single turbines when dual turbines are used. The exact percentage increase or decrease is a function of turbine spacing and air flow.

### TWELVE-INCH DIAMETER TANK

Runs were made in a 12-in. diam. tank with liquid depths, $Z$, of 12 in. and 24 in. Several representative runs are shown in Table 1. The ratio of liquid depth to tank diameter, $Z/T$, was 1.0 and 2.0 (in the 6-in. tank the ratio was 4.67). More power per unit volume was required to give the same coefficient in the large tank than in the small tank. The differences are believed to be almost entirely due to difference in the $Z/T$ ratios. Low $Z/T$ ratios required more power per unit volume for a given coefficient than high $Z/T$ values. It is seldom practical, for mechanical reasons, to use ratios of $Z/T$ larger than about 2.5 in commercial equipment.

The turbine spacing, $S$, in terms of turbine diameter is given by the ratio $S/D$. Industrial equipment seldom is of such proportions as to allow $S/D$ ratios of 3 or more. The 12-in. tank data were obtained for spacings of $S/D$ of 2.0 and 3.0. The effect of these spacings resulted in variations of less than + or − 10% in the absorption coefficient for equal power inputs. Data for the 6-in. tank (Figure 6) show that the maximum or minimum effects of turbine spacing occur at turbine spacings greater than $S/D$ of 5. Variations in the coefficient due to turbine spacings of $S/D$ of 3 and less, result in variations of less than + or − 10% in the 6-in. tank data. Data for the 6- and 12-in. tanks are consistent for the same relative turbine spacings.

Data for the 12-in. tank runs for one air flow rate are shown in Figure 8. Values of the absorption coefficient are given for different power inputs. Liquid levels were used at $Z/T$ values of 2.0 and less. Turbine spacings were used for $S/D$ values of 3.0 and less. Experimental points are shown for single, dual, and triple turbines for arrangements indicated on the figure. Data for twenty-two runs over a wide range of power inputs, show agreement within + or − 10% of the line drawn through the data. This is in agreement with the conclusions reached for similar $S/D$ ratios for the 6-in. tank data. It is apparent that there is relatively little to be gained by the use of two or three turbines rather than a single turbine when the turbine spacing is less than $S/D$ of 3, although small gains can be made by optimum spacing. The minimum spacing in industrial practice is rarely less than $S/D$ of 1.5. The use of multiple turbines in industrial equipment is, therefore, dictated by mechanical rather than by process rate considerations.

Figure 8 also shows the increase in coefficient obtainable by increasing the power applied. The slope of the line is typical of data for single and multiple

**Table 1.—Sample Data, Air Oxidation**

| Run No. | Tank diam. in. | Turbine diam. in. | Liquid depth in. | Turbines on shaft | Turbine position Height off bottom in. 1st | 2nd | 3rd | Turbine speed rev./min. | Power ft.lb./sec. | Hp./gal. × $10^3$ | Air flow superficial ft./sec. | Absorption coefficient $K_La$ × $10^3$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | 6 | 2 | 28 | 1 | 3 | .. | .. | 1,000 | 3.1 | 0.9 | 0.025 | 2.52 |
| 2.10 | 6 | 2 | 28 | 2 | 3 | 5 | .. | 850 | 3.1 | 0.9 | 0.025 | 2.07 |
| 2.11 | 6 | 2 | 28 | 2 | 3 | 7 | .. | 760 | 3.1 | 0.9 | 0.025 | 1.83 |
| 2.13 | 6 | 2 | 28 | 2 | 3 | 11 | .. | 760 | 3.1 | 0.9 | 0.025 | 2.37 |
| 1.4 | 6 | 2 | 28 | 1 | 3 | .. | .. | 1,240 | 6.2 | 1.8 | 0.025 | 3.65 |
| 2.23 | 6 | 2 | 28 | 2 | 3 | 11 | .. | 960 | 6.2 | 1.8 | 0.025 | 3.99 |
| 1.11 | 6 | 2 | 28 | 1 | 3 | .. | .. | 1,640 | 12.3 | 3.6 | 0.025 | 5.68 |
| 2.41 | 6 | 2 | 28 | 2 | 3 | 11 | .. | 1,280 | 12.3 | 3.6 | 0.025 | 7.15 |
| 2.55 | 6 | 2 | 28 | 2 | 3 | 8 | .. | 1,350 | 12.3 | 3.6 | 0.042 | 8.60 |
| 2.61 | 6 | 2 | 28 | 2 | 3 | 14 | .. | 1,300 | 12.3 | 3.6 | 0.042 | 9.48 |
| 2.72 | 6 | 2 | 28 | 1 | 3 | .. | .. | 1,780 | 12.3 | 3.6 | 0.058 | 9.42 |
| 2.74 | 6 | 2 | 28 | 2 | 3 | 8 | .. | 1,350 | 12.3 | 3.6 | 0.058 | 10.35 |
| 140 | 12 | 4 | 12 | 1 | 4 | .. | .. | 835 | 25.2 | 8.32 | 0.10 | 9.9 |
| 135 | 12 | 4 | 12 | 1 | 2 | .. | .. | 793 | 17.5 | 5.80 | 0.10 | 8.5 |
| 132 | 12 | 4 | 12 | 2 | 2 | 10 | .. | 650 | 23.0 | 7.60 | 0.10 | 8.4 |
| 108 | 12 | 4 | 24 | 2 | 4 | 16 | .. | 820 | 53.0 | 8.44 | 0.10 | 10.3 |
| 118 | 12 | 4 | 24 | 3 | 2 | 12 | 22 | 648 | 67.0 | 6.35 | 0.10 | 7.3 |

turbines, and for air rates other than that shown.

### EFFECT OF AIR FLOW

Figure 9 shows the effect of air flow rate on the coefficient at various power levels. The curves are for absorption in a 12-in. tank for single turbines where $Z/T = 1.0$, $D/T = 0.33$ and $C/T = 0.33$. The dotted portions of the lines are extrapolations.

### Discussion

The data of Karow, Bartholomew and Sfat (*3*) showed that in a gas-absorption reaction poorer results were obtained with multiple turbines than with single turbines. Their data were for operations with $Z/T$ ratios of 1.3 and less, for a $D/T$ ratio of 0.5, and for spacings $S/D$ of 1.0 and less. With large diameter turbines ($D/T = 0.5$) and turbine spacings of $S/D$ less than 1.0, it is possible to obtain very peculiar flow patterns. As a result of photographic work (Figure 5) one would anticipate that at low turbine spacings, flow patterns conducive to good gas-liquid contacting could not be achieved and that the use of dual turbines would be much less effective than single turbines.

Data of Oldshue (*5*) showed that the use of multiple turbines would result in either poorer, equal, or better absorption coefficients. These data were for liquid depth to tank diameter ratios of 2.0 and less. The present work with the 6-in. and 12-in. systems is in agreement with these results, and they show further the conditions under which the absorption coefficients can be made to increase or to decrease depending upon the spacing of the turbines, the total power input, and the air flow rate.

Large-scale industrial operations ordinarily use a liquid depth to tank diameter rato of less than 2.5. With this limitation it has not been found possible to increase or decrease absorption coefficients more than 10% by the use of multiple turbines. In a system with liquid depth equal to four times tank diameter it is possible to achieve a 25% increase in the absorption coefficient by the use of multiple turbines, but it is also possible to achieve a 50% decrease if the multiple turbines are not properly positioned. In any case, the advantage of multiple turbines only accrues at high air flows or at high power levels. Disadvantage of multiple turbines may come about at low air flows and low power levels.

The shapes of the curves in Figure 6 show that the effect of regular increases in turbine spacing does not produce regularity in the change of the absorption coefficient.

There is photographic evidence that flow patterns change radically at certain turbine spacings. Turbine speed, fluid velocities, and turbulence will vary for equal power input when the flow patterns change. These factors affect the interfacial area and the mass transfer coefficient; the interaction is a complex one.

### Acknowledgment

Acknowledgment is made to the Commercial Solvents Corporation, Terre Haute, Indiana, under whose Fellowship in the chemical engineering department of Illinois Institute of Technology much of the experimental work reported herein was carried on.

### Notation

- $A$ = total interfacial area of air bubbles
- $a$ = interfacial area per unit volume of liquid
- $C$ = height of lower turbine above tank bottom
- $D$ = turbine diameter
- $F$ = superficial air velocity, distance/time
- $K$ = over-all mass transfer coefficient
- $K_La$ = absorption coefficient based on transfer in liquid
- $K_Ga$ = absorption coefficient based on transfer in gas
- $S$ = spacing between turbines
- $T$ = tank diameter
- $V$ = volume of ungassed liquid
- $w$ = rate of material transfer
- $Z$ = depth of liquid, ungassed
- $\Delta C$ = concentration gradient

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*Presented at A.I.Ch.E. forty-seventh annual meeting, New York.*

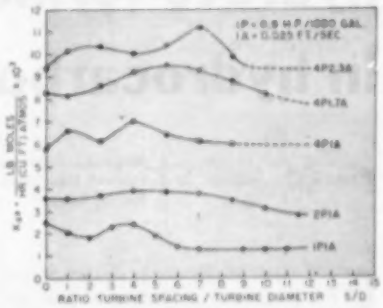


Fig. 6. Absorption coefficient—turbine spacing—power—air flow.

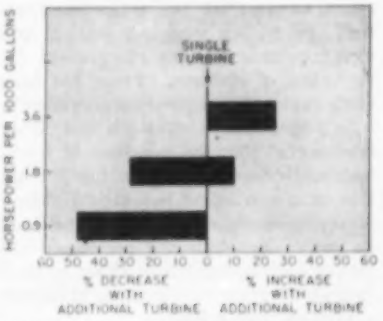


Fig. 7. Single and dual turbine performance.

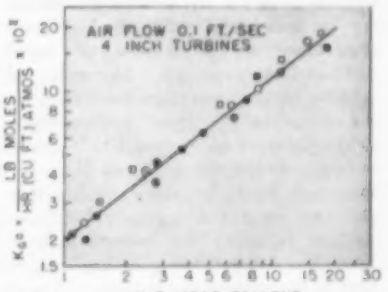


Fig. 8. Single, dual, and triple turbines, 12-inch tank.

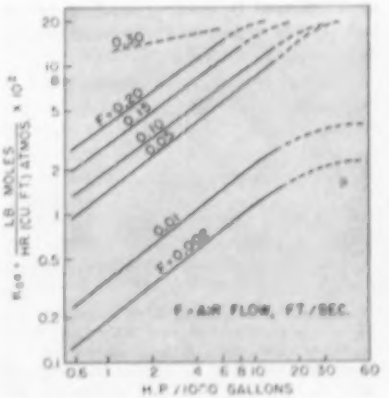


Fig. 9. Absorption coefficients for single turbines.

# Inhibiting hydrate formations in hydrocarbon gases

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Natural Gas Department
Dallas, Texas.*

One of the troublesome problems facing the petroleum industry today is the formation of hydrocarbon gas hydrates.

With the increasing use of central separator batteries, long lines are required to carry oil, gas, and water from well sites to the separator station, and measures must be taken to prevent the formation of hydrates. There has been some evidence in pipe-line operations in which the total well fluid was being transported that the presence of liquid hydrocarbons might aid in the prevention or alleviation of hydrate formation. Experiences encountered in the field are in accordance with the previously observed hydrate-inhibiting effect of non-hydrate-forming constituents. However, a problem still exists.

In addition to the solution of the hydrate problem, the natural gas industry is also faced with the economic importance of condensate or liquid hydrocarbon recovery. In order to achieve better separation conditions for the recovery of liquid hydrocarbons, field separation units should be operated at relatively low temperatures. However, increased liquid recovery by low-temperature separation cannot be obtained without reducing the hydrate menace. Therefore, dehydration is an integral part of the natural gas industry. A wide choice of dehydration techniques is available, such as adsorption with solid desiccants, liquid absorption, compression followed by cooling, cooling below initial dew point, and combinations of the above techniques.

Another technique commonly used in low-temperature separation operations is the injection of glycols into the well stream. Glycols are preferred over alcohols since the glycols can be recovered more economically than the alcohols.

**The choice of glycols or alcohols is a matter of economics and diethylene glycol is generally chosen when the system in question is to be in continuous operation. Therefore, a knowledge of the degree to which aqueous diethylene glycol can inhibit the formation of hydrates would be desirable.**

**Summary and Conclusions**

A laboratory study was undertaken to investigate the effectiveness of both liquid hydrocarbons and glycols in inhibiting the formation of these hydrates. Temperature and pressure conditions for hydrate formation were established for three hydrocarbon gases: natural gas (0.595 gravity), gasoline plant residue gas (0.594 gravity), and casinghead gas (0.698 gravity). For control purposes, duplicate tests were carried out in the presence of an excess of field brine and of distilled water.

Hydrate inhibition tests were made on three mixtures of the natural gas and a saturated hydrocarbon oil in the presence of excess brine, and on two mixtures of the residue gas and an absorber oil in the presence of excess distilled water. Hydrate inhibition tests were made with the natural gas alone, with the use of five different concentrations of diethylene glycol in aqueous solution as inhibitor.

The combined inhibiting effect of liquid hydrocarbons and glycol was observed by the employment of three different mixtures of these agents with the natural gas.

**From the data presented, it can be concluded that:**

1. **The presence of liquid hydrocarbons with a natural gas lowers the hydrate-formation temperature of the gas.**

1a. **Absorber oils produce less temperature depression than the lighter, naturally produced oils.**

2. **Glycol solutions inhibit hydrate formation.**

2a. **Hammerschmidt's relationship for the hydrate temperature depression produced by aqueous nonionic solutions is valid for aqueous glycol concentrations up to 42.5% glycol by weight.**

3. **The combined effect of liquid hydrocarbons and aqueous glycol solutions are not additive but approach additive properties as the gas/oil ratio decreases.**

**History**

Much work has been done towards the solution of the hydrate problem since E. G. Hammerschmidt (*2*) in 1934 proved to the natural gas industry that the "snow" stopping up its pipe lines was hydrocarbon hydrates. Notable contributions to the knowledge and behavior of these hydrates have been made by Hammerschmidt (*2*), who experimented with the effect of methanol, ethanol, isopropanol, and ammonia on the freezing-point lowering of hydrate mixtures. Probably the most important contribution in recent years has been made by Wilcox, Carson, and Katz (*1, 4*), who introduced vapor-solid equilibrium constants and the use of these constants to calculate and predict hydrate-formation conditions from gas composition. Von Stackelberg (*3*) formulated a comprehensive theory for the hydrate crystal structure which predicted that hydrocarbon molecules larger than butanes would not form hydrates. This was in agreement with the experiments of Carson and Katz (*1*), who showed that the binary systems methane-pentane and methane-hexane did not form mixed hydrates.

**Apparatus and Procedure**

Two steel, visual cells were used to study hydrate formation. A high-pressure Jerguson gauge glass having a fluid capacity of approximately 90 cc. was used to observe the hydrate-formation conditions of the test fluids at pressures above 1,000 lb./sq.in.abs. A low-pressure Penberthy gauge glass was used to study hydrate-formation conditions encountered below 1,000 lb./sq.in.abs. Both cells were of the rocker type and jacketed with copper cooling coils and approximately 1 in. insulation, and were connected at the bottom to a calibrated Heise pressure gauge and a high-pressure mercury pump. The temperature of the fluid being tested was obtained by means of a thermometer or a single junction thermocouple mounted in the thermowell of the cell; the temperature was regulated by adjusting the flow rate of cold ethylene glycol through the cooling coils surrounding the cell.

The gas/oil mixtures used in this study were made by combining the individual gas and oil phases in a high-pressure

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Tables 3, 4, 6, 7, and 8, to accompany this paper are on file (Document 4974) with A.D.I. Auxiliary Publications Project, Library of Congress, Washington, D. C. Tabular matter obtainable by remitting $1.25 for photoprints and $1.25 for microfilm.

P.V.T. cell. The analyses of the gas and oil samples were obtained with low-temperature fractionation equipment and the analyses of the combined samples were calculated according to the combined mole ratios.

An excess of the aqueous phase was present during all the experiments. The major part of the work was done by cooling the cell to a desired temperature and maintaining it at that temperature for approximately 15 min. to allow for the establishment of thermal equilibrium. Subsequently, the pressure was increased in increments of approximately 20 lb./sq.in. by the injection of mercury into the cell. Contents of the cell were mixed well after each increase in pressure. The first outward appearance of hydrates was called the "hydrate-point" throughout the experiments. Therefore, it is assumed that the hydrate pressures reported have a maximum error of 20 lb./sq.in. The other procedure followed was one of constant pressure during which the temperature in the cell was slowly lowered by 0.5° increments until hydrates were observed. Also, in all of the above work, it was found that the hydrate-formation conditions had to be exceeded by 300 to 1,500 lb./sq.in. or 3 to 10° F. in order to form hydrates when beginning work on a new system, and all the data presented herein were obtained in the presence of seed crystals.

### Discussion of Results

Results of this laboratory investigation dealing with hydrate formation in two-phase hydrocarbon systems have augmented observations made in the field that hydrates did not form in cases when liquid hydrocarbons were present although the conditions favored hydrate formation. The fluids tested in this study were chosen because they were directly or indirectly involved in a company operation in which the hydrate problem was also involved. Table 1 presents the analyses of the fluids.

Table 2 presents distillations of the stock tank oil and absorber oil.

### ANTIFREEZE EFFECT OF BRINE

The hydrate-formation conditions for gas (A) were determined in the presence of an excess of brine (80,000 p.p.m. salts) and again in the presence of excess distilled water. Figure 1 presents these data along with data predicted with the method Carson and Katz developed for vapor-solid equilibria. The test brine caused an average temperature depression of approximately 1.4° F. as compared to pure water.

The depression was slightly greater than average in the higher pressure range. A comparison of the hydrate conditions obtained experimentally in the presence of distilled water with those predicted from the vapor-solid equilibrium constants of Carson and Katz shows a fair agreement, and it is evident that the hydrate-formation conditions predicted from the vapor-solid equilibrium constants will provide the user of these constants with a conservative estimate of the hydrate conditions to be expected for a natural gas-water system.

### ANTIFREEZE EFFECT OF LIQUID HYDROCARBONS

Figure 2 shows the hydrate pressure-temperature relationships in the presence of excess brine for gas (A) and mixtures of gas (A) and the separator oil.

On the assumption that the depression effect of the brine on the various systems shown here was constant, the depressant or antifreeze properties resulting from the presence of known quantities of oil in the mixtures can be attributed directly to the oil itself.

The introduction of small quantities of oil to produce gas/oil ratios of 9,000 cu.ft./bbl. or higher exhibited limited antifreeze effects closely approximate to those for the original natural gas (A).

A system with a gas/oil ratio of 4,483 cu.ft./bbl. caused significant depressions of the hydrate temperature below that of natural gas (A).

The 1,000 cu.ft./bbl. system exhibited more pronounced antifreeze effects. It is seen in Figure 2 that a sharp rise in hydrate-formation pressure occurred at relatively low temperatures when a one-phase hydrocarbon region was approached by liquefaction of the gas as the pressure was increased.

Isobaric plots of data on hydrate formation for natural gas (A) and for mixtures of natural gas (A) and separator oil are shown in Figure 3.

That hydrate-formation in two-phase hydrocarbon systems is not considered to be a significant function of gas composition is best illustrated in Figure 4. Here the actual experimental data are compared to a curve representing hydrate-formation pressures calculated for the equilibrium gas phase existing immediately prior to the formation of hydrates for the 4,483 cu.ft./bbl. system, and at the hydrate-formation temperature obtained experimentally. A definite effect has been produced by some factor other than gas composition. In this case this factor was considered to be the presence of the liquid hydrocarbons. Table 5 presents the composition of the gas and oil phases for this system calculated by the use of the vapor-liquid equilibrium ratios of Winn (*5*).

### EFFECT OF MOISTURE

A few experimental observations were made with gases (B) and (C) at 965 lb./sq.in.abs. It was found that in the case of gas (C), a 0.698 gravity gas which had a water dew point of 60° F., no visible hydrates were formed in the presence of only the water of condensation when the temperature was lowered gradually to 32° F. Although this one observation is not at all conclusive, it is reasonable to conclude that sufficient water was not present to satisfy any visible hydrate equilibrium. With excess water added to the system, gas (C) formed a hydrate at 61.1° F. and 965 lb./sq.in.abs. Also in the presence of

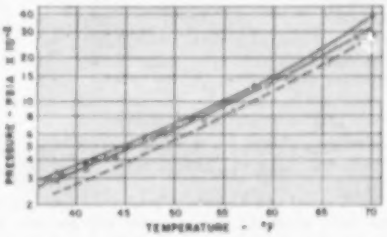



Fig. 1. Hydrate formation conditions for gas A.
○ gas A—distilled water
△ gas A—8 per cent brine
—·— gas A—distilled water (calculated)

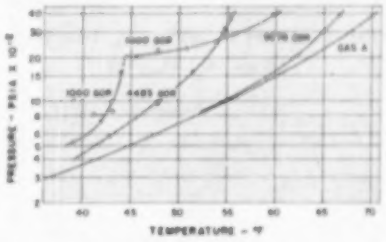



Fig. 2. Hydrate formation conditions for gas A and three mixtures of gas A and separator oil in presence of field brine.

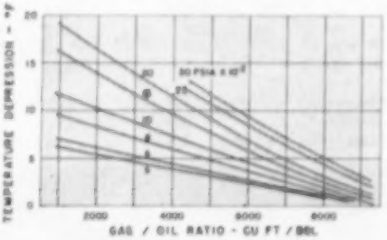
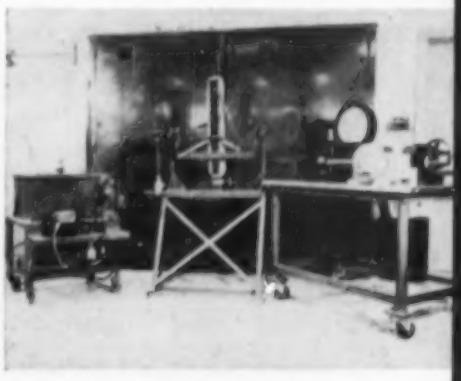



Fig. 3. Antifreeze effect produced by liquid phase of two-phase hydrocarbon system.



Photograph of experimental apparatus.

**Table 1.—Analyses of Natural Gases, Separator Oil, and Recombined Hydrocarbon Fluids**

| Component | Mole Per Cent | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | Recombined Fluids [b] | | |
| | Gas (A) | Gas (B) | Gas (C) | Oil [a] | 1,000 cu.ft./bbl. | 4,483 cu.ft./bbl. | 9,270 cu.ft./bbl. |
| Carbon dioxide | 0.42 | ..... | ..... | ..... | 0.15 | 0.33 | 0.37 |
| Methane | 94.97 | 93.03 | 86.33 | 27.35 | 51.27 | 80.39 | 87.35 |
| Ethane | 2.96 | 6.17 | 6.03 | 3.60 | 3.37 | 3.10 | 3.03 |
| Propane | 0.81 | 0.48 | 3.15 | 2.22 | 1.72 | 1.11 | 0.97 |
| Isobutane | 0.20 | 0.19 | 0.90 | 0.89 | 0.65 | 0.35 | 0.28 |
| N-butane | 0.36 | 0.05 | 1.12 | 2.51 | 1.75 | 0.83 | 0.60 |
| Pentanes | 0.18 | 0.08 | 0.94 | 2.76 | 1.85 | 0.73 | 0.47 |
| Hexanes plus | 0.10 | ..... | 1.53 | 60.76 | 39.24 | 13.16 | 6.93 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

[a] Analysis of oil at 85° F. & 1,115 lb./sq.in.abs., mole. wt. hexanes plus = 148, mole. wt. stock tank oil = 142.
[b] Calculated, recombined fluids of gas (A) and separator oil (above).

Gas (A) is a high-stage production gas; gas (B) is a gasoline plant residue gas; gas (C) is a casinghead gas, and the oil is a high-stage separator oil being produced simultaneously with gas (A). The recombined fluids are combinations of gas (A) and the separator oil with the gas/oil ratio referred to here being the ratio of the total gas of the system (S.T.P.) referred to a barrel (42 gal.) of oil at 60° F. and 14.7 lb./sq.in.abs.

**Table 2.—Engler Distillation of Stock Tank Oil and Absorber Oil**

| Per Cent Distilled | Temperature—° F. | |
|---|---|---|
| | Stock Tank Oil | Absorber Oil |
| Initial B.P. | 113 | 384 |
| 5 | 183 | 417 |
| 10 | 219 | 428 |
| 20 | 263 | 439 |
| 30 | 302 | 444 |
| 40 | 347 | 449 |
| 50 | 396 | 453 |
| 60 | 440 | 456 |
| 70 | 477 | 463 |
| 80 | 516 | 482 |
| 90 | 570 | 512 |
| 92.5 | 604 | ... |
| 100 | ... | 606 |
| Recovery | 92.5 % | 100% |
| Residue | 5.0 | ... |
| Loss | 2.5 | ... |

excess water gas (B) formed a hydrate at 56.5° F. and 965 lb./sq.in.abs. Both the observed hydrate temperatures above are approximately 2° F. lower than the temperatures which would be predicted from vapor-solid equilibria relationships (*1*).

### EFFECT OF ABSORBER OIL

Several observations were made on gases (B) and (C) at 965 lb./sq.in.abs. with the results being reproducible to within 0.5° F. Gas (B) when mixed with a 191 mole. wt. absorption oil at a gas/oil ratio of 2,700 cu.ft./bbl. formed hydrates at a temperature of 49.5° F. and a pressure of 965 lb./sq.in.abs. This indicated a temperature depression of 7.0° F. due to the presence of the absorber oil. Similarly, a 9.0° F. depression was obtained when the gas/oil ratio was lowered to 1,015 cu.ft./bbl. These depressions are 2.3 and 2.5° F. less than the depressions which would be predicted from Figure 3. This discrepancy can possibly be explained by the fact that absorber oils contain fewer light ends than production oils.

### COMPARATIVE CONTENTS OF GASES vs. HYDRATES

The hydrates of gases (B) and (C) were decomposed after the gas phase had been displaced from the cell, and the gases which were in the hydrates were displaced and collected. The gravities of the hydrated portions of gases (B) and (C) were determined experimentally, and the amount of gas in each hydrate was measured. The experimental gravity determinations revealed close checks with similar data calculated

**Table 5.—Calculated Analyses of Equilibrium Gas and Oil Phases for 4,483 cu.ft./bbl. System at Conditions of Hydrate Formation**

| Component | Mole Per Cent | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 42.8° F. — 575 lb./sq.in.abs. V/L = 4.00 | | 47.8° F. — 975 lb./sq.in.abs. V/L = 3.26 | | 51.5° F. — 1,615 lb./sq.in.abs. V/L = 2.33 | | 54° F. — 2,550 lb./sq.in.abs. V/L = 1.52 | | 55.4° F. — 3,775 lb./sq.in.abs. V/L = 1.00 | |
| | Gas (A) | Y | X | Y | X | Y | X | Y | X | Y | X |
| Carbon dioxide | 0.42 | 0.35 | 0.15 | 0.36 | 0.22 | 0.36 | 0.29 | 0.34 | 0.30 | 0.35 | 0.32 |
| Methane | 94.97 | 95.38 | 19.40 | 95.71 | 30.43 | 95.90 | 44.10 | 95.55 | 57.41 | 93.74 | 67.03 |
| Ethane | 2.96 | 3.04 | 3.36 | 2.82 | 4.03 | 2.63 | 4.19 | 2.61 | 3.80 | 2.77 | 3.42 |
| Propane | 0.81 | 0.72 | 2.70 | 0.65 | 2.62 | 0.60 | 2.30 | 0.65 | 1.81 | 0.79 | 1.44 |
| Isobutane | 0.20 | 0.14 | 1.22 | 0.12 | 1.09 | 0.12 | 0.89 | 0.15 | 0.65 | 0.21 | 0.50 |
| N-Butane | 0.36 | 0.26 | 3.17 | 0.23 | 2.79 | 0.24 | 2.22 | 0.31 | 1.63 | 0.45 | 1.20 |
| Pentanes | 0.18 | 0.10 | 3.32 | 0.09 | 2.80 | 0.11 | 2.17 | 0.17 | 1.59 | 0.31 | 1.14 |
| Hexanes plus | 0.10 | 0.10 | 66.68 | 0.02 | 56.02 | 0.04 | 43.84 | 0.22 | 32.81 | 1.38 | 24.95 |
| | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |

Tables 3, 4, 6, 7, and 8 are on file with A.D.I. (see footnote on page 324).

from vapor-solid equilibrium constants with the use of vapor-liquid flash equations. Results of these checks are shown in Table A.

#### Antifreeze Effect of Aqueous Glycol

Some previous work has been done to determine the antifreeze properties of nonionic solutes in aqueous solutions. The work of Hammerschmidt (*2*) was concerned with aqueous solutions of methanol, ethanol, isopropanol, and ammonia in concentrations ranging from 5 to 20 wt. % of solute in water. From this work he developed the following relationship:

$$d = \frac{2335\ W}{100\ M - MW}$$

where

$d$ = temperature depression, ° F.
$W$ = wt. % solute
$M$ = mole. wt. solute

Figures 6 through 8 present the experimental results obtained with the use of aqueous solutions of diethylene glycol and triethylene glycol as antifreeze agents. Figure 6 shows the hydrate pressure-temperature relationships for natural gas (A) in equilibrium with hydrate and with several weight percentages of aqueous diethylene glycol solutions.

The depressions caused by the various glycol concentrations were averaged arithmetically for each concentration and the curves presented here were drawn parallel to the hydrate curve for gas (A) and displaced according to the average temperature depression. The actual experimental data were added later. The hydrate curves were extrapolated in the low-pressure region to the freezing point of the aqueous solution.

A comparison of the experimental data and the temperature depressions which would be predicted from Hammerschmidt's equation is presented in Figure 7. In the range covered by Hammerschmidt, the experimental data agree well with the predicted values. Deviations shown here do not warrant any change in the empirical relationship presented by Hammerschmidt in its application to diethylene glycol solutions up to 42.5%.

#### Combined Antifreeze Effect of Liquid Hydrocarbons and Aqueous Glycols

The addition of liquid hydrocarbons to the natural gas-glycol mixture re-

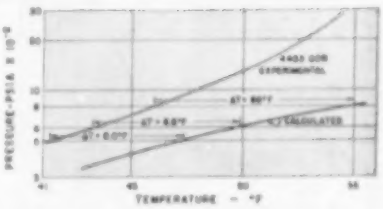



Fig. 4. Comparison of experimental data for 4,483 cu.ft./bbl. hydrocarbon system and data predicted from equilibrium gas phase composition.

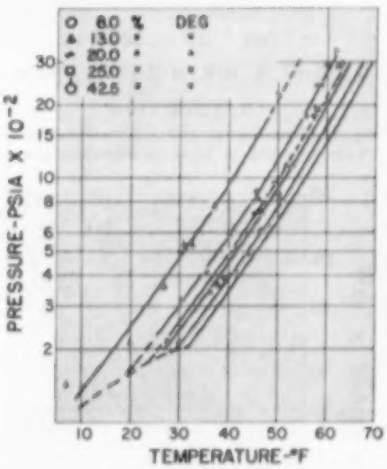
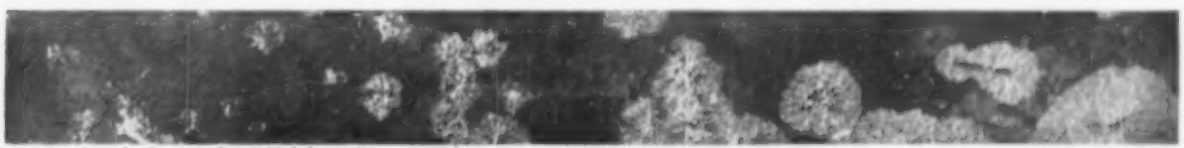



Fig. 6. Hydrate formation conditions for gas A in presence of aqueous diethylene glycol.

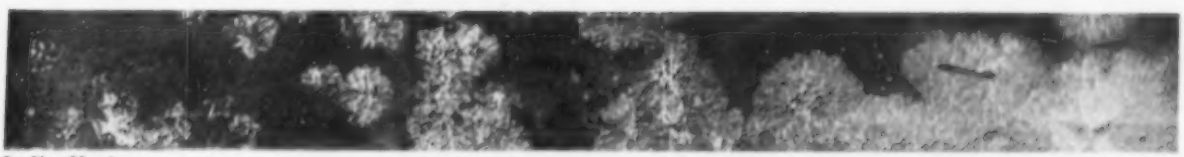
**Table A.**

| | Volume Per Cent of Original Gas as Hydrate | | Gravity (Air = 1.0) | |
|---|---|---|---|---|
| | experimental | calculated | experimental | calculated |
| Gas (B) | 9.6 | 5.6 | 0.704 | 0.692 |
| Gas (C) | 11.3 | 11.3 | 0.821 | 0.815 |

Fig. 5. Hydrate of gas A formed at 405 lb./sq.in.abs. and 43° F. in presence of excess distilled water.



1. Approximately 5 min. after initial formation.



2. Plus 20 min.

3. Plus 1 hr., 20 min.

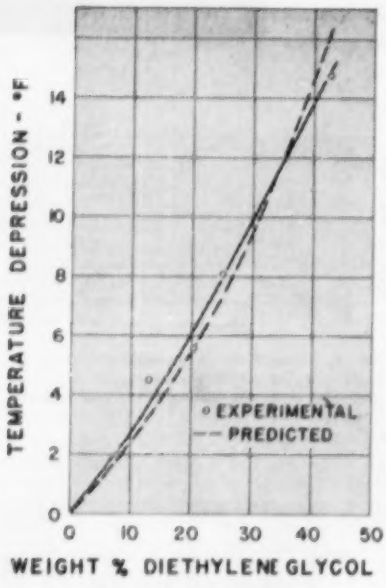



Fig. 7. Experimental and predicted antifreeze effects produced by aqueous diethylene glycol.

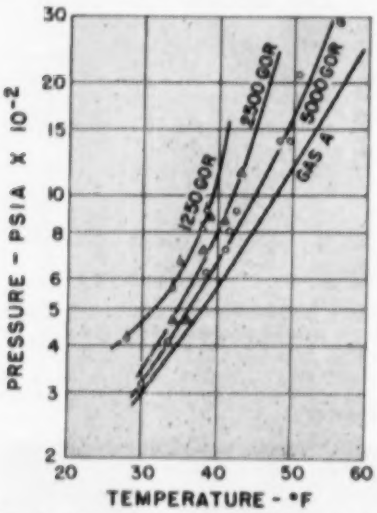



Fig. 8. Hydrate formation conditions in two-phase hydrocarbon systems in presence of aqueous diethylene glycol (25 wt. % diethylene glycol).

○—5,000 cu.ft./bbl.
△—2,500 cu.ft./bbl.
◇—1,250 cu.ft./bbl.

sulted in further depressions of the hydrate temperatures as shown by Figure 8. It is seen that temperature depression increased with decrease in gas/oil ratio as evidenced previously. However, the depressions due to the liquid hydrocarbon phases here did not equal those previously obtained for the same gas/oil ratios when no glycols were present. The temperature depressions obtained for the 5000 gas/oil ratio mixture averaged 56.8 per cent of that which would be predicted for this system. The 2500 and 1250 gas/oil ratio systems were 70.5 and 82.1 per cent effective, respectively. The lessening of the temperature depression to be expected if both the glycol and the liquid hydrocarbon exhibited their full depressant effects can be attributed chiefly to the solubility of the oil in glycols.

### Degree of Crystal Growth

Although agitation is necessary to form the first hydrate crystals, it was observed that crystals will continue to grow in the hydrate phase without agitation. Figure 5 presents three photographs taken of the hydrate of gas (A) formed in distilled water at 405 lb./sq.in.abs. and 43° F. The crystal growth, although small in magnitude, is clearly visible. The first panel was taken approximately 5 min. after the first crystals were observed. Immediately following the last photograph, the cell was rocked several times and this resulted in a more extensive formation of hydrates.

Hydrates formed during the presence of a liquid hydrocarbon phase seemed to be in greater abundance than any of the hydrates formed in the one-phase gaseous systems. In the high pressure cell, the formation of the hydrates was sufficient to stop completely the gravity flow of fluids in the cell. It is believed the stoppages occurred at the small, ⅛-in.-diam. opening connecting the chambers of the cell. In the presence of glycol solutions only, the gas did not form hydrates as abundantly as the hydrates formed when an oil phase was present. Therefore, a difference is established as to the relative effects of glycol and hydrocarbon oils. Although the glycol acts to depress the hydrate temperature, it also reduces the degree of hydrate formation. This reduction in hydrate formation was evident when experiments were made with the higher glycol concentrations. On the other hand, it seems that the oil suppresses the formation of hydrates and the end effect is similar to the effect produced by supercooling without the presence of an oil phase.

### Theoretical Aspect

The mechanism by which the hydrates are formed in the presence of liquid hydrocarbons is not known at this time. However, the activity of the various components is influenced by the presence of an oil phase. Von Stackelberg (*3*) describes the structure of a hydrate as consisting of a basic unit cell containing 48 water molecules which form eight "holes" into which hydrocarbon molecules can fit. The heavier hydrocarbons which form hydrates supposedly reduce the number of openings by distortion. Possibly the heavier hydrocarbons interfere with the mechanism of hydrate formation in such a fashion as to distort the openings described by Von Stackelberg sufficiently to produce the effects found experimentally. Katz (*6*) has suggested that some water-soluble components of the oil may enter the mobile vacant lattice positions. This could occur to a small degree since the solubility of paraffinic components is approximately 0.00001 mole % and aromatics and unsaturated components are soluble to approximately 0.0001 mole % and would in effect reduce the activity of the water phase and lower the hydrate temperature.

The effect of aqueous glycol solutions is chiefly the lowering of the activity of the aqueous phase by the glycol. A minor influence is created by the solubility of the lighter gas components in the glycol; however, the effect of the glycol on the aqueous phase activity is still the controlling factor.

The effects created in the systems involving both the glycol and liquid hydrocarbon phases are due mainly to the solubility relationships of oil and glycol. The presence of oil in the aqueous phase reduces the effective concentration of the glycol, and thereby decreases the activity of the aqueous phase to a level less than is encountered without a liquid hydrocarbon phase. This reasoning seems valid since oils are virtually insoluble in water and are soluble to a degree in diethylene glycol. It is possible that the oil molecules are completely associated with glycol molecules.

### Acknowledgment

The author wishes to express his appreciation to L. G. Sharp and E. B. Elfrink of Magnolia's Field Research Laboratories for their critical review of the results and their help in formulating the laboratory program. Appreciation is also extended to O. Baker and W. Swerdloff of Magnolia's Natural Gas Department for their help and suggestions in initiating the program and to the management of the Magnolia Petroleum Company for its permission to publish these data.

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2. Hammerschmidt, E. G., *Ind. Eng. Chem.*, **26**, 851-855 (1934).
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**ESSO'S PILOT PLANT OPERATIONS COMMITTEE**

**Serves as a central body to:**

- BRING TOGETHER available information on pilot plant techniques from all the Jersey groups.
- SPONSOR special studies in new areas of pilot plant technology.
- COORDINATE comparative test work on available or special pilot plant equipment.
- CATALOG AND DISTRIBUTE design and operating information.
- SPONSOR specialized training programs for operating personnel.
- BRING TO THE ATTENTION of management problems of a general nature having to do with improving the effectiveness of pilot plant operations.

# Esso improves performance and combats high costs of pilot plant operations

*W. W. Boisture,* E. W. S. Nicholson,† W. O. Taff ‡*

When the pilot plant phase of process development in new chemical and petroleum processes has been reached, it is often necessary to expend great quantities of energy, time, and materials in order to bring the project to a successful conclusion. Often these high costs will deter or limit the scope of a new process development, and management, therefore, must be on the watch always to see that research funds are being expended wisely on projects that are likely to yield the highest returns. The over-all efficiency with which pilot plant operations are executed has a marked influence on the effectiveness of any research program and many times spells the difference between success and failure of a project. Traditionally, these high costs have been accepted as another calculated risk associated with development; however, there are indications that a number of companies are now giving attention to increasing the efficiency and lowering the costs of their pilot plant operations (*1, 2, 3*).

Engineers of the Standard Oil Company (New Jersey) family of research affiliates have, over the past three years, been making a concerted effort to reduce the cost of the pilot plant phase of their new process developments. As an outgrowth of many informal discussions, both at the management and operating levels of the company, concerning the

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need for developing data and exchanging information on pilot plants, a permanent company-wide Pilot Plant Operations Committee was organized late in 1952.

Management personnel from the Esso Research and Engineering Company, Esso Research Laboratories, and other research affiliates serve as a steering committee to direct the activities of the general committee which is composed of representatives of U. S. research affiliates as well as others such as Imperial Oil Limited of Canada and the Esso Research, Limited, in England, and the various refining divisions. Members of the steering committee serve on a rotational basis with a new chairman and secretary being appointed each second year. The primary objective of this committee is to improve the over-all effectiveness of Jersey's pilot plant operations.

### Annual Meetings to Discuss Pilot Plant Problems

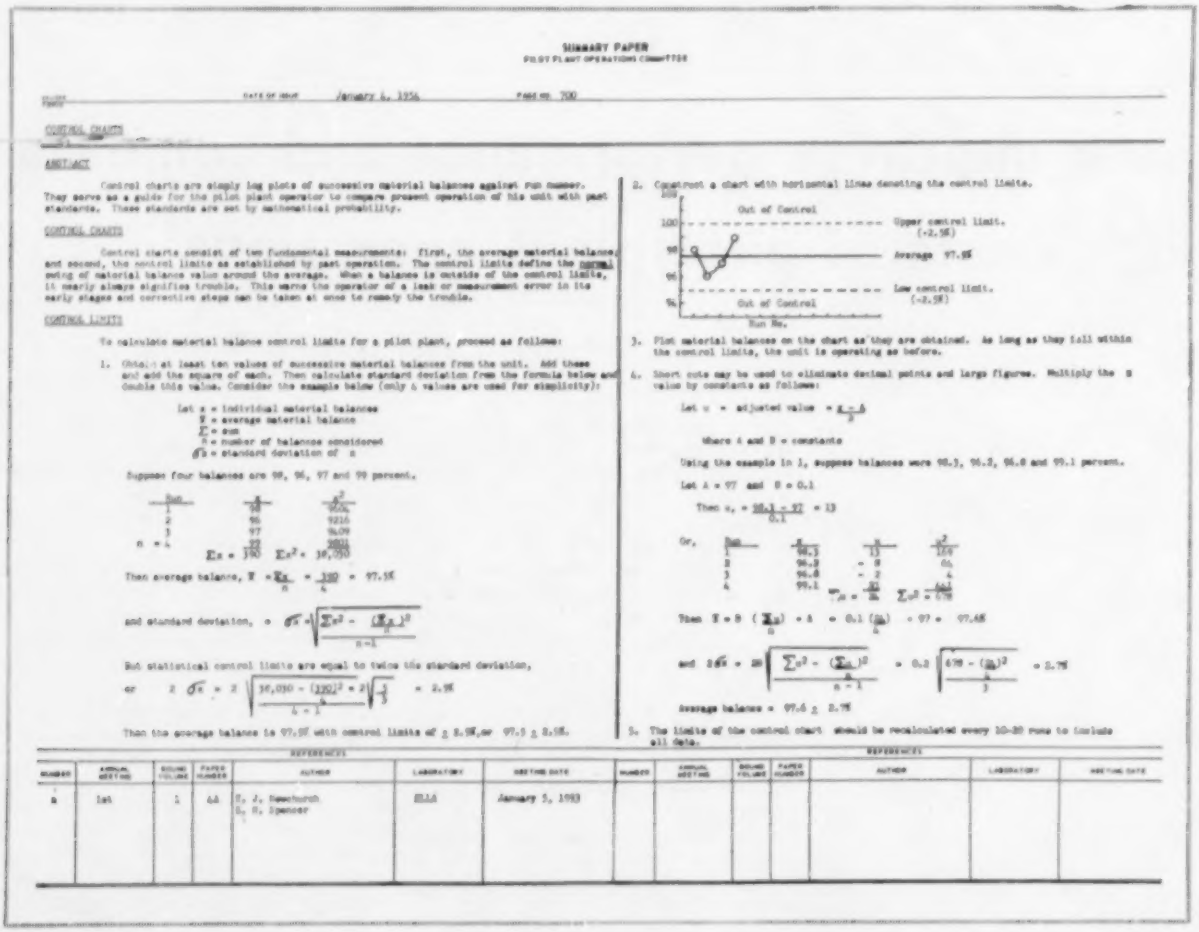
Under the committee's sponsorship, annual meetings at one of the research laboratories give Jersey's research men an opportunity to report on new developments in design and operating techniques of general interest and to plan future programs aimed at reducing pilot plant costs. These meetings are conducted on an informal basis with considerable time being allowed for reviewing the reports and for visiting members to inspect the plants of the host division and discuss the current operating problems on these units. The informal atmosphere has done much to improve the spirit of cooperation and to promote the exchange of ideas among personnel of the various divisions. The committee feels that this factor alone has been one of the major benefits of the entire program.

The programs of the annual meetings are directed usually toward a thorough treatment of some phase of pilot plant operations such as design practices, material balance improvement, maintenance, and personnel, and for the most part, the papers presented deal with some facet of the general topic. A high point of each meeting is a one-day seminar on some subject of general interest to the group. These discussions are led usually by an outside consultant in the field under discussion and lend much interest to the over-all program. Such topics as scale-up, statistical techniques as applied to pilot plant operations, and use of pilot plant data in commercial plant design have been covered in recent meetings and have effected many worthwhile developments. At the end of each annual meeting, copies of the papers presented are bound as a formal report and are distributed on a limited basis to the various affiliates to serve as permanent reference sources.

### References for the Pilot Plant Engineer

To give the engineers a handy day-to-day reference source, summaries are prepared on each subject discussed at the meetings. Limited to a single page, these summaries include abstracts of the paper, comments from the group, and conclusions or recommendations. In addition to the summaries, the pilot plant operators are provided with other spe-

Figure 1.



SUMMARY PAPER
PILOT PLANT OPERATIONS COMMITTEE

Unit: Pilot
Date of Issue: January 1, 1956
Page no. 700

CONTROL CHARTS

ABSTRACT

Control charts are simply log plots of successive material balances against run number. They serve as a guide for the pilot plant operator to compare present operation of his unit with past standards. These standards are set by mathematical probability.

CONTROL CHARTS

Control charts consist of two fundamental measurements: first, the average material balance; and second, the control limits as established by past operation. The control limits define the normal swing of material balance value around the average. When a balance is outside of the control limits, it nearly always signifies trouble. This warns the operator of a leak or measurement error in its early stages and corrective steps can be taken at once to remedy the trouble.

CONTROL LIMITS

To calculate material balance control limits for a pilot plant, proceed as follows:

1. Obtain at least ten values of successive material balances from the unit. Add these and add the square of each. Then calculate standard deviation from the formula below and double this value. Consider the example below (only 4 values are used for simplicity):

Let x = individual material balances
$\bar{x}$ = average material balance
$\Sigma$ = sum
n = number of balances considered
$\sigma$ = standard deviation of x

Suppose four balances are 98, 96, 97 and 99 percent.

| Run | $x$ | $x^2$ |
|---|---|---|
| 1 | 98 | 9604 |
| 2 | 96 | 9216 |
| 3 | 97 | 9409 |
| 4 | 99 | 9801 |
| n = 4 | $\Sigma x = 390$ | $\Sigma x^2 = 38,030$ |

Then average balance, $\bar{x} = \frac{\Sigma x}{n} = \frac{390}{4} = 97.5\%$

and standard deviation, $\sigma = \sqrt{\frac{\Sigma x^2 - \frac{(\Sigma x)^2}{n}}{n-1}}$

But statistical control limits are equal to twice the standard deviation,

or $2\sigma = 2\sqrt{\frac{38,030 - \frac{(390)^2}{4}}{4-1}} = 2\sqrt{\frac{5}{3}} = 2.5\%$

Then the average balance is 97.5% with control limits of ± 2.5%, or 97.5 ± 2.5%.

2. Construct a chart with horizontal lines denoting the control limits.




3. Plot material balances on the chart as they are obtained. As long as they fall within the control limits, the unit is operating as before.

4. Short cuts may be used to eliminate decimal points and large figures. Multiply the x value by constants as follows:

Let u = adjusted value = $\frac{Ax - A}{B}$

where A and B = constants

Using the example in 1, suppose balances were 98.1, 96.2, 96.8 and 99.1 percent.

Let A = 97 and B = 0.1

Then $u_1 = \frac{98.1 - 97}{0.1} = 11$

Or,

| Run | $u$ | $u^2$ |
|---|---|---|
| 1 | 98.1 | 121 |
| 2 | 96.2 | - 8 | 64 |
| 3 | 96.8 | - 2 | 4 |
| 4 | 99.1 | 11 | 121 |
| | $\bar{u} = \frac{20}{4}$ | $\Sigma u^2 = 190$ |

Then $\bar{x} = B\left(\frac{\Sigma u}{n}\right) + A = 0.1\left(\frac{20}{4}\right) + 97 = 97.5\%$

and $2\sigma_x = 2B\sqrt{\frac{\Sigma u^2 - \frac{(\Sigma u)^2}{n}}{n-1}} = 0.2\sqrt{\frac{190 - \frac{(20)^2}{4}}{3}} = 2.5\%$

Average balance = 97.5 ± 2.5%

5. The limits of the control chart should be recalculated every 10-20 runs to include all data.

REFERENCES

| Number | Annual Meeting | Bound Volume | Paper Number | Author | Laboratory | Meeting Date |
|---|---|---|---|---|---|---|
| 8 | 1st | 1 | 44 | E. J. Newchurch<br>D. H. Spencer | ESLA | January 5, 1953 |

REFERENCES

| Number | Annual Meeting | Bound Volume | Paper Number | Author | Laboratory | Meeting Date |
|---|---|---|---|---|---|---|
| | | | | | | |

cial engineering, design, or equipment information of practical use to them. A typical summary is shown in Figure 1. As new techniques are developed or as better equipment becomes available, the summaries are modified.

#### Interim Projects Speed Up

The Pilot Plant Committee sponsors each year a number of special projects on subjects of broad and long-range importance. These projects are reviewed periodically at meetings of the steering committee and a formal report is then issued at the time of the annual meetings.

#### EQUIPMENT SURVEYS

In several cases these interim projects have taken the form of surveys of available equipment for pilot plant applications. In such surveys various manufacturers were asked to submit cost and service data on equipment for specific applications and, in addition, members of the committee were requested to submit comments on various types of equipment which had been used in similar applications. In some instances limited equipment-testing programs were set up to provide further data not available from the sources just referred to. All this information was then compiled and studied by a small group of engineers; the recommendations of this group were presented at the annual meetings and then published in summary form. Surveys have been completed on pumps, variable-speed drives, pressure fittings, temperature and level controllers, and control valves.

#### COOPERATIVE DESIGN STUDIES

During the past few years many equipment manufacturers have designed and produced process and control equipment specifically adapted for pilot plant work. Members of the committee have been active in helping the manufacturers establish design specifications and, in some cases, actually have tested the prototypes in pilot plant service. These efforts have certainly helped to establish a better understanding by the manufacturers of the demand for equipment designed especially for pilot plant work.

One such project which is currently underway is of particular interest. Committee members are working with various valve manufacturers on the development of a new line of valves especially designed for pilot plant service. This project was undertaken about two years ago after an extensive survey of ways to improve material balances and service factors on Jersey's pilot units had indicated that valve failures, of one type or another, were a major problem. A study of valves then commercially available showed that the various divisions had to stock a wide variety of makes, types, and sizes, each best suited for a limited number of applications, in order to carry on its operations. Valve manufacturers were contacted and they indicated an interest in the development of a suitable line of valves should the demand be large enough to justify the effort. Jersey's engineers, working with manufacturers' representatives, developed the problem in detail and active design work on the new valves was undertaken early in 1955. The committee feels that such joint design efforts with the manufacturers in the development of new and specialized equipment for pilot plants will pay dividends by giving tomorrow's design man the equipment best suited to the job.

#### PERSONNEL AND COMMUNICATIONS

The committee has been active in other fields of a more general nature and has worked with other units of the company in studying such problems as operator incentives, training, and communications. Some of these studies are yet in the development stage; however, one, concerning the problem of establishing and maintaining effective communications (*4*) in pilot plant operations, was recently completed at the Esso Research Laboratories in Baton Rouge, Louisiana.

Realizing that in any effort success cannot rise above one's ability to communicate clearly ideas and information to other people, the committee took a critical look at the effectiveness of communications in Jersey's pilot plant activities. The findings were rather startling; much time, data, and sometimes even equipment were being lost when "communication breakdowns" occurred. Indications were that even a relatively small improvement in this area could be worth a lot. Consequently, the pilot plant group at the Baton Rouge Laboratories was asked to study this problem and submit recommendations to the committee at the earliest possible date.

During the early phases of this study it became apparent to this group that both the operating personnel and the technical supervisors were equally responsible for poor communications and that in many instances communications were poor because of *attitude* as well as the inability to communicate. It was evident that this difficulty could probably be most effectively attacked by enlisting the help of a capable, unbiased person who was not associated with either labor or management. To fill this role, the group was fortunate in securing a well-known consultant in the field of communications from the Louisiana State University.

The purpose of the study was clearly explained to all operating and supervisory personnel concerned and it received the wholehearted support of both groups. Subsequently, in a series of individual interviews and group meetings with the operating personnel, the problem was clarified from the standpoint of the members of this group. Then, in a number of round-table discussions in which members of both groups participated, recommendations were developed to improve the over-all effectiveness of communications, first from technical man to operator and, second, from operator to technical man. These recommendations were then made available to all divisions in the form of an interim report (*5*) to serve as a permanent guide to better communications.

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## CORRECTION

In the article *Reversible Filtration* (*C.E.P.*, June, 1956, page 238), authored by Judson Granger Brown, certain figures in Table 1 on page 240 are not in their correct horizontal positions.

The $23.00 does not represent "Cost/million gal.," but rather the "12% return on investment before taxes, overhead," which is a sub-item under "Cost/million gal." The $7.60, the cost of the reversible filter, also belongs horizontally on the same line with the "12% return on investment before taxes, overhead." On a line with the item "Power," there should be a blank (as there is) under "rapid sand filter," and $7.50 under "reversible filter."

**What new tools and techniques are available to the chemical engineer for solving air pollution problems? Here are the results of a survey conducted for the American Institute of Chemical Engineers.**

# Some new engineering tools and techniques for CLEANER AIR

*O. C. Thompson* — Carbide and Carbon Chemicals Company, South Charleston, West Virginia.

*G. W. Blum* — Goodyear Tire and Rubber Company, Akron, Ohio

The phenomenal growth of industry during the past decade (particularly the chemical industry), along with rapid population growth, has intensified pollution problems.

The American Institute of Chemical Engineers organized an Industrial Waste Disposal Committee in 1947. In recent years the committee, now called the Pollution Control Engineering Committee, has embraced the problems both of atmospheric pollutions and liquid waste disposal. A Subcommittee on Air Pollution was assigned the task of determining the availability of new tools and techniques.

### Survey Procedure

A list of prospects was compiled from membership in the Air Pollution Control Association, from the attendance records at meetings of technical societies and associations, and from other sources. Included in the list were equipment manufacturers, production companies in such industries as chemical, steel, electrometallurgical, and oil refining; trade associations, control agencies, government departments, colleges, universities, institutes and foundations; consulting engineers, technical and trade associations; and publications.

A letter sent to each prospect stressed the particular interest currently in new or unique devices or techniques intended for the identification, measurement, or reduction of air pollution. The letter also requested prompt return of a printed form, with the addresses of any other prospects not included in the original list, a copy of which went with each survey letter. In response stacks of catalogs, brochures, published papers, letters, and names of prospects were received.

### Results of Survey

Table 1 summarizes the distribution of the completed questionnaires received. The column titled "additional" represents sources suggested by those who received the original questionnaire.

Some new tools and techniques employ the latest application of electronics, tracer elements, light diffraction, and complicated instrumentation. (Such work deserves more detailed treatment than space permits.) The few singled out for specific reference were selected for their special interest to chemical engineers. It does not necessarily follow that they represent greater achievements or are of more value than developments which could not be included.

Selections discussed below are classified into three broad categories:

1. Identification
2. Measurement
3. Pollution reduction

**Table 1.**

| | Original | Additional | Total |
|---|---|---|---|
| Industrial and equipment manufacturing companies | 144 | 35 | 179 |
| Institutes and foundations | 15 | 13 | 28 |
| Government departments (state and federal) | 14 | 13 | 27 |
| Colleges and universities | 26 | 13 | 39 |
| Technical societies | 4 | 2 | 6 |
| National laboratories | 3 | ... | 3 |
| Commercial laboratories | 2 | 3 | 5 |
| Associations | 8 | 12 | 20 |
| Control agencies | 47 | 7 | 54 |
| Consulting engineers | 4 | 4 | 8 |
| Periodicals (other than by technical societies) | 2 | 1 | 3 |
| | 269 | 103 | 372 |

## IDENTIFICATION

**A thermal precipitator aerosol sampler** which will collect bacteria without destroying them or preventing later culture has been developed by Kethley, Gordon and Orr (Georgia Tech.). With polarized light, it determines number of particles in the sample, particle size, radioactivity, and chemical content (*1*).

**Odor Perception** has been studied by the American Society of Heating and Air Conditioning Engineers. Their initial findings were published in June, 1956 (*2*).

**Centrifugal Sedimentation** methods for measuring size distribution of small particles and their concentration in airborne dusts have been studied by Whitby. Under sponsorship of the American Society of Heating and Air Conditioning Engineers and in cooperation with the University of Minnesota, he has published substantial data on the subject (*3*).

**Millipore Filters** are being used increasingly for analysis and assay. They permit the determination of microbiological aerosols and electron microscopic examination (*4*).

**The Aerosoloscope Counter**, designed by Armour Research Foundation, counts suspended particles from 1 to 64 $\mu$ at a rate up to 2,000/sec. and classifies this count into twelve size ranges (*5*).

**A Counter-Photometer**, produced at

the University of California, employs an improved right-angle optical system and a single electron multiplier phototube. This instrument was designed to identify particles in the Los Angeles atmosphere which affect visibility, and to segregate them into twenty separate size groups (*6*).

**Gas Chromatography** analytical techniques have been developed by the Tennessee Eastman Company. By this method, it has identified ethane, propane, ethylene, acetylene, and propylene in the smoke from burning paper and rags (*7*).

**Infrared** process instruments, the Trinon and the Bichromator, produced by the Perkin-Elmer Corporation, provide a continuous analysis of one component of a sample stream pumped through the cell. A Trinon is being used to detect ½ p.p.m. acetylene in air in the intake of an oxygen plant. A Bichromator is being used for a military air pollution monitoring requirement (*8*).

**Microslides,** with submicron particulates being exposed to suitable reagents in the gaseous state, have been investigated by Canada's Occupational Health Laboratory. This continues the work of Leroux and others in Paris (*9*).

**A Midget Cyclone and Filter Combination** for stack sampling, **a Fluoride Recorder** (not yet fully developed), and a **Sectioning Technique** by which air-borne particles collected by filtration can be mounted and sectioned without removal from the filter, have been reported by the Stanford Research Institute (*10*).

**An Improved Venturi Scrubber,** a portable instrument with which large volumes of air can be scrubbed by a small volume of liquid, makes possible more concentrated solutions for analysis (*11*).

**Weeds as Pollution Indicators.** The type and intensity of pollution can often be indicated by the effects on certain weeds (*12*).

**Plant Fluorescence to Indicate Smog Damage.** Ultraviolet light brings out characteristic damage by pollutants (*13*).

The Air Pollution Foundation has reported (October 23, 1955) several important new tools in its study of the causes and cures for smog: **A Four-Way Continuous Analyzer** records four atmospheric variables on a single 4-point strip chart recorder. These variables are nitrogen dioxide, nitric oxide, oxidant and oxidant precursors. (The term *oxidant precursor* refers to material in the atmosphere which is responsible for oxidant formation when the air is irradiated with sunlight) (*14*).

**The Ozone Radiometer** shoots ultraviolet rays across a short space to a receiver (*14*).

**A Carbon Monoxide Recorder** was stepped up in sensitivity by addition of pressure cells to keep a continuous check on the carbon monoxide in the air. A number of these are in use (*14*).

**A Hydrocarbon Recorder** was needed and a laboratory model is now in experimental use (*14*).

### MEASUREMENT

**Aerial Sampling by Helicopter** has been developed by the T.V.A. A recent stack-sampling problem may add significance to some of the difficulties involved. It was considered necessary to sample the plume from a 200-ft. boiler stack and to follow the smoke plume for a considerable distance. A helicopter was available but was originally given up when it was discovered the rotors pumped air downward at the rate of 13,000 cu.ft./sec. However, the T.V.A. team overcame this and other difficulties in the use of the helicopter (*16*).

**Unburned Hydrocarbons** in the exhaust of automotive engines have been intensively studied by the automotive industry with a view to measurement and reduction. Four papers on this subject were presented at the 1955 annual meeting of A.P.C.A. (*17*).

**An After-Burning Muffler,** containing no catalysts, has been developed by the Clayton Manufacturing Company. It operates by air injection with electric ignition. An evaluation report on this device has been issued by the Air Pollution Control District of Los Angeles County (*18*).

**The Dustex Single Tube,** offered by the Dustex Corporation, gives accurate measurements of dust problems under actual operating conditions (*19*).

**A Smoke Density Indicator** measures directly the degree of obscurity of smoke or haze passing between a light source and a photoelectric scanner (*20*).

The following measuring instruments are supplied by the Mine Safety Appliance Company: **A Settlement Dust Counter** determines the true count of dust particles or air-borne bacteria (*21*).

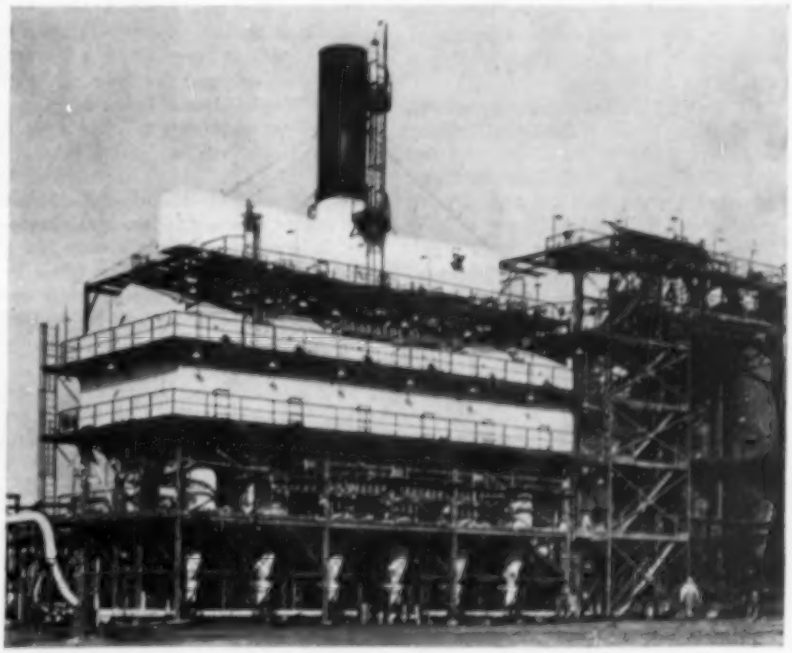
**An Infrared Gas and Liquid Analyzer** is available (*21*).

**The Cascade Impactor** has nearly 100% collection efficiency for liquid or solid particles from 0.7$\mu$ up to 50$\mu$ (*21*).

**A Midget Impinger,** portable and hand operated, will sample at a rate of 0.1 cu.ft./min. This instrument is specially serviceable in isolated locations (*21*).

**An Electrostatic Sampler** is offered which is designed for all types of particulates including dust, fumes of molten metal, and smoke (*21*).

**The Smokescope** estimates smoke density. A paper has been published comparing the Smokescope with the Ringelmann Chart (*21*).



A bag filter unit manufactured by the American Wheelabrator and Equipment Corp. installed at the Phillips Chemical plant at Borger, Texas.

**Automatic Equipment** for sampling and measuring smoke and dust is offered by the Research Appliance Company. A typical instrument, the **Dill Dust-Spot Tester,** is designed to measure accurately the efficiency of all types of air filters in ventilating systems (*22*). Actual atmospheric contamination is used as the test basis (*23*).

**Size Distribution of Aerosol Particles** is determined by a new method based on precipitation of charged particles in an electrostatic field. This development is reported by Victor K. LaMer, Columbia University, whose department is at present developing an **Electrical Discriminator** for measuring much smaller particle sizes.

**An Aerometric Survey** has been made in Los Angeles. Findings have been published by the Air Pollution Foundation. This survey required the use of the latest tools and techniques and indicated the need for still further refinements (*24*).

**A Scale Model Wind Tunnel** at New York College of Engineering represents something new in the way of air-pollution investigation. Density and ejection speed of gases from stacks as well as wind speed and direction are reproduced in the model (*25*).

## *REDUCTION*

**An Electrostatic Precipitator,** serving as an agglomerating agent, is followed by **Cyclone Collectors** in an air-pollution reduction system developed by Research-Cottrell, Inc. (*26*).

**A Centrally Located Precipitator** with automatic controls is used for cleaning the gases from a number of open-hearth furnaces. This is also a Research-Cottrell installation (*26*).

**Carbon Black Recovery Equipment,** installed for Phillips Chemical Company by Research-Cottrell, was supplemented by a tertiary bank of cyclones operating in parallel with the Research-Cottrell installation. This system gave a 95 to 97.5% collection efficiency, but air pollution was still present. Complete recovery was decided on, and for this a bag filter was selected (*27*).

**Blast Furnace Gas** is being cleaned in nine installations of Pease-Anthony Venturi Scrubbers by Chemical Construction Corporation. These scrubbers handle 100,000 cu.ft./min. and reduce dust loading from 3 to 20 g./std.cu.ft. to 0.003 to 0.05 g./std.cu.ft. One unique feature is that they utilize wasted top pressure on blast furnaces; thus, this cleaning operation is done without additional energy costs. (*28*).

**Elemental Sulfur Recovery** from roaster gases with the use of liquid sulfur as the scrubbing medium to absorb an aerosol of sulfur, is being carried out by Pease-Anthony Venturi Scrubbers (*29*).

**Odor Elimination** by absorption in fuel oil is another application of Pease-Anthony Scrubbers. After becoming saturated with the odor components, the fuel oil is burned under boilers, thus destroying the odor.

In another application odors from sewage sludge dryers are absorbed and burned in a similar manner. It is proposed further to use diesel oil to absorb ventilation gases from sewage sludge tankers during the filling operation. In this case the diesel oil, containing the odor components, will be burned in the diesel engines which operate the tankers (*29*).

**Submicron Iron Oxide Fumes** are being removed from off-gases resulting from a new method of making steel. Better than 99% of such fume is being successfully eliminated, and this renders the stack gases essentially invisible except for a white steam plume. This is also a Pease-Anthony installation (*29*).

**Fume Recovery** installations of Pease-Anthony Venturi Scrubbers have been in operation for nineteen months at the Thilmany Pulp and Paper Company. Recovery efficiencies approximate 90%, plus a bonus as heat-recovery equivalent to the evaporation of 12,000 lb./hr. of additional water, thereby saving more than 3,000 lb. of steam/hr. (*30*).

**Combustion Gases** from a pilot incinerator for radioactive combustible solid waste are being cleaned at the Knolls Atomic Power Laboratory by an adaptation of a Pease-Anthony Scrubber (*31*).

Leslie Silverman supplied sufficient evidence of the work of the School of Public Health at Harvard for an entire paper. Among these developments are: **A Slag Wool Filter** is being developed for high-temperature gas cleaning for the American Iron and Steel Institute (*32*).

**A Mechanical Electrostatic Unit** uses a new principle. Here a mechanically induced electrostatic charge on a fixed fabric charges a moving fabric by contact. Due to the mechanically induced charge, efficiency can be doubled with no increase in air flow resistance (*33*).

**A Variable Porosity Filter** was developed at the Air Cleaning Laboratory at Harvard. This is reported by Melvin W. First who, prior to becoming a consultant, was on the staff there. Dr. First is now working with Flanders Mill, which is using the principle in its new **Air-Pure Expansible Dust Filter.** Accelerated test procedure indicates the principal field of application to be the high efficiency cleaning of atmospheric air where dust removal requirements are far greater than the capabilities of the usual supply-air filter (*34*).

**A Deep Bed Filter** for temperatures up to 1,500° F. has been developed by the Carborundum Company, with the cooperation of the Buffalo Forge Company. Dr. First acted as technical consultant for this development. The filter medium is *fiberfrax*, a ceramic fiber. Publication of this work is expected soon.

**Incinerator Performance** has been improved by the installation of grids of new design. These *Dehydra Vent* grids of high alloy steel with matching grooves, are produced by the Sodel Company of Cleveland. They are mounted in the side walls of the combustion zone and are heated to 800° F. with a gas flame. The combustion gases and entrained material must pass to the stack through cylindrical slots in the hot grids. The resultant close contact with preheated surfaces assures more complete combustion. Municipal pollution control agencies have improved the performance of a number of old, inefficient units by installation of these grids.

**Agglomeration of Submicron Dust Particles** has been accomplished by passing them through flames that produce smoke. This new discovery, made in September of last year, was announced by Fain Ingram, Director of the Bureau of Air Pollution of Chattanooga. A pilot plant unit has been set up at the Tennessee Products and Chemical Company to evaluate this discovery (*35*).

**Air Pollution Reduction** installations by the American Wheelabrator and Equipment Corporation include several on electric steel melting furnaces and forty-eight in the carbon black producing industry. (One of the latter is the bag collector at Phillips Chemical Company, Borger, Texas) (*36, 37*).

**A Centrifuge Collector Unit,** practically abrasion free, has been developed recently by the Fly Ash Arrestor Corporation. It handles dust loadings up to 40 gr./cu.ft. and requires little servicing owing to plugging. It features a collecting cylinder rotating at 1,500 to 2,500 rev./min., depending upon the required collection efficiency (*38*).

**The Solivore Gas Scrubber,** designed for removal of dust particles below 10$\mu$, is offered by the Ventil Corporation. A spray generator fills the entrance chamber with a fine mist, wetting the fine dust. The gas then passes down through a Venturi where expansion occurs. This expansion causes condensation and coats the surfaces of the dust particles with a liquid film. The Venturi diffuser drops the pressure and agglomeration occurs. This process is repeated in a second chamber where a coarser mist creates a scrubbing effect (*39*).

**Sulfur Recovery** from $H_2S$ is one of the Girdler Company's specialties. A number of such units are in operation (*40*).

**The Catalytic Oxidation Process,** offered by Catalytic Combustion Corporation, is claimed to be unique in that no contaminants are produced to cause other pollution—either of air or water. It is also claimed that a high percentage of these installations are self-amortizing by the recovery of heat energy which was formerly wasted in the form of objectionable fumes. A wide range of such applications is cited. These include removal of hydrocarbon, organic, organic-sulfur, and nitrogen compounds from gas, fume or aerosol phases (*41*).

**Oxy-Catalyst** also offers a process based on catalytic oxidation. More than 3,000 fork lift trucks are now equipped with the Oxycat catalytic exhaust unit. They are used on payloaders in the holds of ships, in underground mining operations, and in many other confined locations (*42*).

**Oxycat** is also reported to be effective for cleaning up industrial pollutants in concentrations that vary from close to the explosive point to a few parts per million. The Pennsylvania Health Department has confirmed the effectiveness of the first factory installation which was designed to treat the fumes from ovens for baking synthetic lacquers and enamels on metal coils—24 to 30 drums of xylols, toluols, and other solvents a day.

After 68l units were in operation, not a trace of odor could be detected. Heat recovery from the oxidation reduced heat requirements by 90%, resulting in savings of $2,700 a month. Original cost of the catalytic units was $13,000.

After three years of operation, the Enamelstrip Corporation, in whose plant this first industrial unit was installed, reports a 400% increase in production of the ovens and a 95% reduction in insurance rates. The original Oxycat units are said to be still removing more than 99% of the pollutants (*43, 44*).

### Partial Review of Work by Other Groups

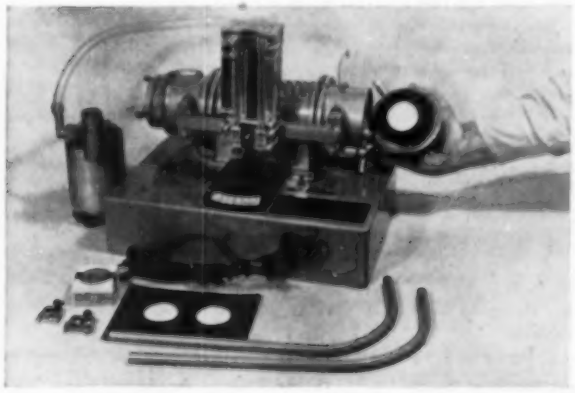
Other technical societies and industrial companies have been active in air-pollution control work.

The A.I.Ch.E. and the A.C.S. include symposia on air pollution in their meetings. The A.C.S. now makes biennial reviews of the literature on air pollution.

The M.C.A. has sponsored a number of air-pollution conferences on a national level. The Air Pollution Abatement Committee's Manual (*45*) has had wide acceptance. It is kept up to date by the addition of supplements as new methods and techniques are developed. The most recent of these was the supplement to Chapter 6, titled "Sampling Procedures and Measuring Equipment."

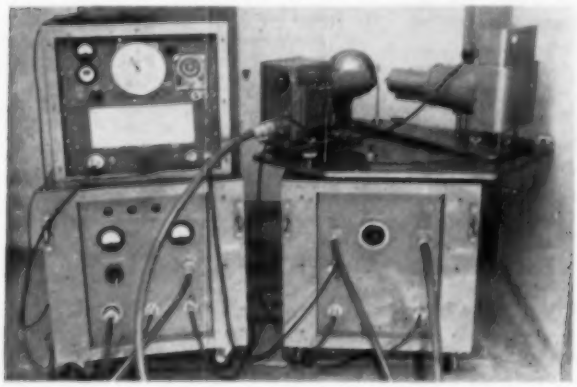
The A.S.M.E has sponsored an International Congress on Air Pollution in addition to carrying on a variety of other services. Three of these include a semimonthly news clipping magazine *Smog*, issuance (1953 and 1955) of "Guide to Research in Air Pollution" and publication (June, 1955) of "Instruments for the Study of Air Pollution."

The A.P.I., through a Committee on Disposal of Refinery Wastes, publishes a five-volume manual titled "A.P.I. Man-

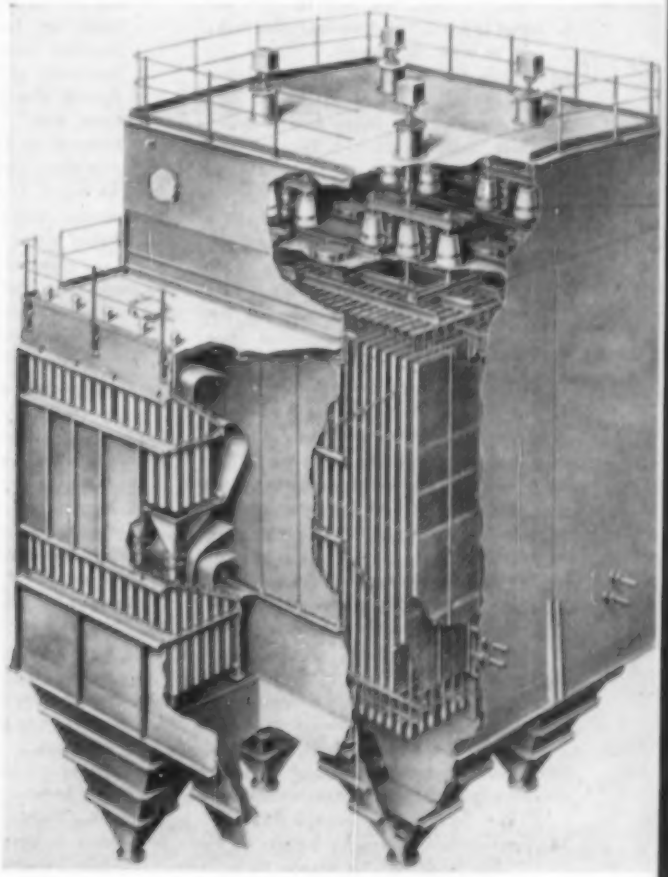


The Dill Dust-Spot Tester by the Research Appliance Co.

Aerosol Camera developed by Stanford Research Institute.



Combination mechanical and perforated plate precipitator by Research Cottrell, Inc.



ual on Disposal of Refinery Wastes," dealing with all refinery wastes, both liquid and gaseous. Vol. II includes air pollution.

#### Industry Pioneers New Tools and Techniques

It is most regrettable that this paper cannot do justice to the many splendid achievements in this field by industry. For example, the interest and financial support of the American Iron and Steel Institute made possible the invaluable work of the Industrial Hygiene Foundation at Mellon Institute. Here W.C.L. Hemeon and his associates developed a number of our present-day tools for identification and measurement (*46*).

Some of the advanced instruments now in use in the Los Angeles area were developed as a result of the initiative taken by the oil refining member companies of the Western Oil and Gas Association which developed a program and spent $1,500,000 to finance basic research. This work has been taken over by the American Petroleum Institute through its Smoke and Fumes Committee (*47*).

Among the many companies of achievement in pollution control, outstanding is the Kaiser Steel Company at Fontana. Here, a staff of seventeen operates an Air Control and Research Department which not only handles a monitoring and control program but also has delved deeply into the chemistry of the open-hearth furnace and its effluent system (*48*).

#### Economics

This paper has dealt primarily with the technology of air-pollution control. It is also important, however, to consider the economics involved in industrial air-pollution control. There is a widely accepted belief that the time and expense for air-pollution reduction can be justified only for its public relations value. In many cases, this statement is not applicable.

Four pollution abatement installations by Carbide and Carbon Chemicals Company can be cited as fairly typical—three of these have been completed, the fourth has been approved. All four installations were authorized solely because of the company's concern for the good will of the plant communities. Yet, two of the three completed projects have actually made a satisfactory return on investment.

For one of these projects a new design has been developed which is expected to increase the economic attractiveness. In this case, an appropriation request for more than $500,000 is being recommended as economically justified.

The proposed fourth project involves a capital investment of just under $200,000. It is designed to reduce still further losses to the atmosphere from a recent Carbide and Carbon plant. This pollution reduction installation is conservatively estimated to return 30 per cent on the investment. These experiences point up the desirability of investigating the economic aspect of pollution abatement early in the project study.

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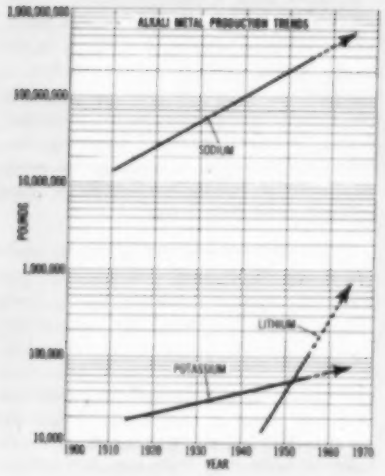



Fig. 2. Alkali metal production trends.

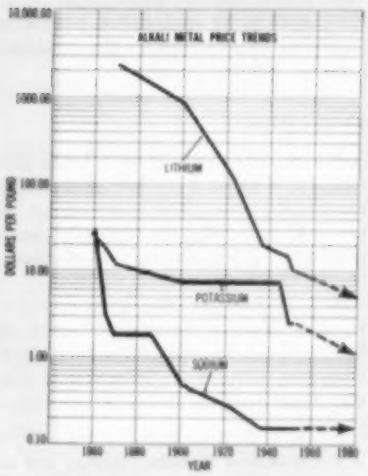



Fig. 3. Alkali metal price trends.

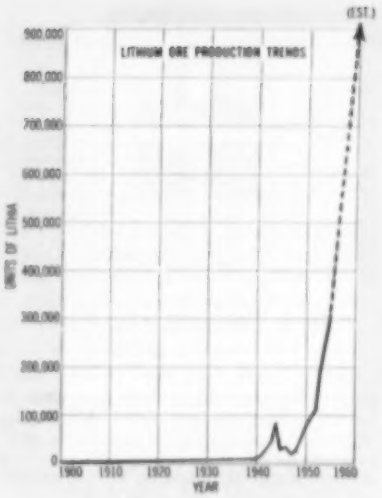



Fig. 7. Lithium ore production trends.

**The manufacture of the alkali metals is becoming an increasingly significant industrial enterprise. The accompanying paper reviews the various manufacturing processes, giving some brief historical background as a general introduction to a comparison of thermochemical and electrolytic methods. Future trends for the alkali metals are indicated as upward, particularly in the case of sodium and lithium.**

# Manufacture and Availability of the Alkali Metals

*Marshall Sittig* | Ethyl Corporation, New York

Sodium, lithium, and potassium (in that order) are the alkali metals of greatest commercial importance. Rubidium and cesium are sold only in gram quantities at the present time. Cesium, however, as the most reactive of the alkali metals, shows interesting research possibilities and may well assume a more important position in the alkali metal family in the future.

### Manufacture

Manufacture of the alkali metals is becoming an increasingly significant industrial enterprise. Whereas the alkali metals were discovered first as a result of the electrolysis of their molten salts, early manufacturing processes were primarily based on thermal reduction. Then in the case of sodium and lithium at least, manufacturing swung over entirely to electrolytic methods. Now increased research emphasis is being placed on thermochemical methods, and others of the alkali metals may join potassium in being produced by thermal reduction.

The alkali metals can, in general, be manufactured by one of two general techniques: (*1*) electrolysis of molten salts (usually the halides or the hydroxide), and (*2*) thermochemical reduction of a salt (usually the carbonate and sometimes the halide) by such agents as carbon, iron, calcium carbide or one of the alkali or aklaline-earth metals.

Present processes for the manufacture of the alkali metals consist of reduction of the chlorides—electrolytically in the cases of sodium and lithium—and by sodium reduction at high temperature in the case of potassium.

Figure 1 illustrates the trends in processes for the manufacture of sodium.

Manufacturing facilities for the various alkali metals are heavily concentrated in the United States with about 85 per cent of world sodium production capacity in this country (and probably similar percentages of potassium and lithium capacity).

Data on production of the various alkali metals is given in Figure *2*, and Figure *3* depicts graphically the steadily decreasing prices of the metals which have accompanied the production increases.

### LITHIUM METAL

Lithium metal is produced by the electrolysis of lithium chloride. The process, employed by Lithium Corporation of America in 1951 and described by Hader, Nielsen and Herre (*15*) seems to be generally similar to that described by Smatko (*24*) in F.I.A.T. Report 786.

A steel cell containing a carbon refractory lining for corrosion resistance is employed along with graphite anodes and steel cathodes. The electrolyte is a fused eutectic mixture of lithium chloride and potassium chloride. The lithium metal is removed from the surface of the cell by the use of a special ladle and is transferred to ingot molds. Figure 4 shows the German lithium cell design. The metal may be

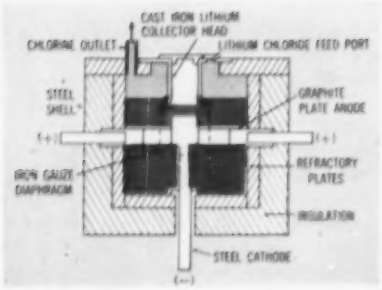



**Fig. 4. Cross section of lithium cell.**

purified by remelting, whereupon most of the impurities either sink or float (15). Molten lithium is withdrawn from the midpoint of such a furnace to molds in which finished shapes are prepared for the market.

Preparation of extremely pure lithium by distillation has been discussed by Baker, Duncan and Greene (*5*).

Unlike the other alkali metals, lithium cannot be produced by carbon reduction of its compounds since a stable carbide is formed. Lithium oxide can be reduced by magnesium, iron, or aluminum, but such processes never have been commercialized.

Lithium metal is apparently being produced by four United States companies: American Potash and Chemical Company, Foote Mineral Company, Lithium Corporation of America, and Maywood Chemical Corporation.

American Potash and Chemical is assumed to be producing lithium because it has manufactured lithium hydride which is prepared directly from the metal.

Foote Mineral Company is understood to be manufacturing the metal. Eigo, Franklin and Cleaver (*11*) mention the method used by Foote in preparing the metal. See also Meyer (*20A*).

Lithium Corporation of America is a major producer of the metal. It was being produced at the St. Louis Park, Minnesota, plant of Lithium Corporation at the rate of 8,000 lb. a month in May, 1954 (*1*). Plans for a substantial increase in metal production were announced late in 1955.

Maywood Chemical Corporation is another large producer of lithium metal at its Maywood, New Jersey, plant.

Owing to the fact that only two producers (Lithium Corporation and Maywood) have been in the field until recently, lithium metal production figures have never been disclosed. Now, military requirements have imposed an additional veil of secrecy. The little, available information on metal production in 1954 was summarized by Sittig (*22*). Eigo, Franklin and Cleaver (*11*) in an otherwise comprehensive report on lithium production simply stated that "maximum lithium metal capacity in 1955, with three or four top producers supplying, is estimated in the neighborhood of 400,000 pounds."

## SODIUM METAL

About 95 per cent of the world's production of metallic sodium is made by the electrolysis of molten sodium chloride in Downs cells, the remainder being produced by the electrolysis of caustic by the Castner process.

The Downs cell has been described in some detail in the original patent by Downs (*10*) and in subsequent literature (*19, 12*). It is illustrated in Figure 5.

**Sodium is produced in the Downs cell with a molten mixture of sodium chloride and calcium chloride as an electrolyte. The calcium chloride (66.8%) is added to reduce the melting point of the bath from 803° C. (for pure sodium chloride) to 505° C. for the eutectic mixture.**

**As shown in Figure 5, the sodium leaves the cell through a finned riser pipe which is air cooled. In this riser pipe, the sodium-calcium alloy produced at the electrode (containing perhaps 2% Ca) is precipitated out and falls back into the bath where it reacts to form more of the eutectic melt. Chlorine is produced at the anode as a coproduct from the cell.**

World production of sodium is about 300 million pounds annually with about 260 million of this being produced in the United States.

The largest producer of sodium is the Ethyl Corporation with plants at Baton Rouge, Louisiana, and at Pasadena, Texas. The next sodium producer is E. I. du Pont de Nemours & Company with a plant at Niagara Falls, New York, and a second plant scheduled to go into production at Antioch, California, in 1957. The third producer—listed in order— is National Distillers Products Corporation with a plant at Ashtabula, Ohio, built in 1951 and now being expanded, primarily to supply requirements of the adjacent Electrometallurgical Company titanium plant at Ashtabula. The three United States producers have a total capacity at 260 million pounds of sodium.

European sodium producers include Imperial Chemical Industries in England, Deutsche Gold und Silber Scheideanstalt (Degussa) in Germany, and many smaller producers.

## POTASSIUM METAL

The manufacture of potassium in the United States has been described by Jackson and Werner (*17, 18*). The process employed is illustrated schematically in Figure 6.

**As shown there, a distillation column packed with stainless steel rings is the reaction vessel. Molten potassium chloride at 1,550° F. is fed to the midpoint of the column. Sodium is vaporized in the reboiler and sodium vapors rise upward countercurrent to the downward-flowing potassium chloride. Operating conditions can be varied to permit sodium potassium alloy of various compositions or pure potassium to be distilled over.**

Other thermochemical methods, analogous to those used for sodium and with carbon as a reducing agent, have not been satisfactory for potassium since potassium reacts with the carbon monoxide produced in such processes to form an explosive carbonyl (sodium does not form a carbonyl). Even so, some mixed sodium and potassium have been obtained as by-products in the Pidgeon process for magnesium when the dolomite fed to the process contained sodium and potassium salts.

Electrolytic techniques for potassium manufacture have never been successful for the following reasons:

1. **Potassium has a high vapor pressure at possible cell-operating temperatures, leading to undesirable metal mist formation.**
2. **Corrosion is troublesome at the melting point of the chloride and satisfactory eutectics have not been developed to lower this temperature.**
3. **Potassium reacts with oxygen more readily than does sodium and cell designs (the Castner cell, for example) do not provide adequate protection from the air.**

A report (F.I.A.T.) by Smatko (*23*) depicts a novel thermal process for potassium manufacture.

**Potassium fluoride was reduced with calcium carbide, or preferably with silicon. A coal-fired reverberatory furnace was used and the potassium was distilled out and collected under mineral oil. It was reported that this process was simpler to operate and more economical than electrolytic manufacture of potassium. The Callery process certainly sounds more straightforward and more economical than this German process, however.**

Potassium is produced in the United States only by Callery Chemical Company, a subsidiary company of Mine Safety Appliances Company at Callery, Pennsylvania, by the process described earlier in this paper. Thorpe (*25*) stated in 1950 that "there is no industrial demand for potassium today and no manufacturing process on any appreciable scale is known to be operating." Thorpe goes on to state that there was interest in potassium as a reducing agent for other metal chlorides in the 1800's but that the advent of cheap sodium had destroyed the demand for potassium. The electrolysis of sodium

hydroxide is cited as a method which could be employed for making potassium if the demand should arise. Recent studies have indicated, however, that electrolytic methods for potassium offer more difficulties than does the present-day electrolytic process for sodium, therefore, the Callery method seems to reign unchallenged today.

#### Trends in Manufacturing Processes

Research and development continue on manufacturing processes for the alkali metals, the stimuli for which include the following:

**Broadening markets requiring additional production facilities.**

**Desire for lower manufacturing costs.**

**Possibility of using alkali metal alloys directly in processing, by-passing alkali metal manufacture; this suggests new electrolytic cell designs.**

**Local shortages of electric power; this suggests a trend to thermochemical processes under some conditions.**

#### New Processes

##### LITHIUM METAL

A new chloride volatilization process has been announced recently for the recovery of lithium from pegmatite. This process has been described by Colton (*6*) and has been the subject of a patent by Cunningham (*7*).

**It consists of the roasting of spodumene with calcium chloride at 1,500-1,900° F. yielding lithium chloride. The lithium chloride is recovered in aqueous solution. Bureau of Mines pilot plant work on this process has been reported by Fraas and Ralston (11A).**

##### SODIUM METAL

Research emphasis on sodium manufacturing process seems to be on thermal reduction of soda ash with coke, as evidenced by a recent series of patents. A gaseous mixture of carbon monoxide and sodium vapor results from this process. Sodium is recovered by absorption in molten tin according to techniques described by Deyrup (*8*) and by Deyrup and Knox (*9*) of Du Pont. These patents are somewhat similar to earlier patents by McConica, MacPhail and Kirk (*20*) and by Griswold and McConica (*13, 14*) of Dow. The Dow process involved heating of carbon with sodium carbonate in an arc furnace at 1,200° C. The sodium vapor was absorbed in a lead alloy from which it could be recovered in a subsequent distillation step.

The necessity for separating sodium from carbon monoxide is avoided in a process patented by Hansley (*16*) which involves the preparation of sodium ferrite and the subsequent reaction of sodium ferrite with iron according to the following equations:

$$Na_2CO_3 + Fe_2O_3 \rightarrow 2NaFeO_2 + CO_2 \quad (1)$$

$$NaFeO_2 + Fe \rightarrow 2FeO + Na \quad (2)$$

Electrolytic processes for sodium manufacture are constantly under study, and one recent development which has excited interest is a new lead-cathode cell design (*2*). A thin stream of molten lead is used as the mobile cathode in the electrolysis of molten salt in this cell, developed by Szechtman. Actually the idea of a lead-cathode cell is old in the art, but the unique constructional details of the Szechtman cell are claimed to give low cost sodium-lead alloy from which sodium can be recovered at small additional cost.

##### POTASSIUM METAL

The simplicity of the thermal reduction of potassium chloride by sodium and the inherent difficulties of making potassium electrolytically indicate no immediate prospects for new processes for potassium manufacture.

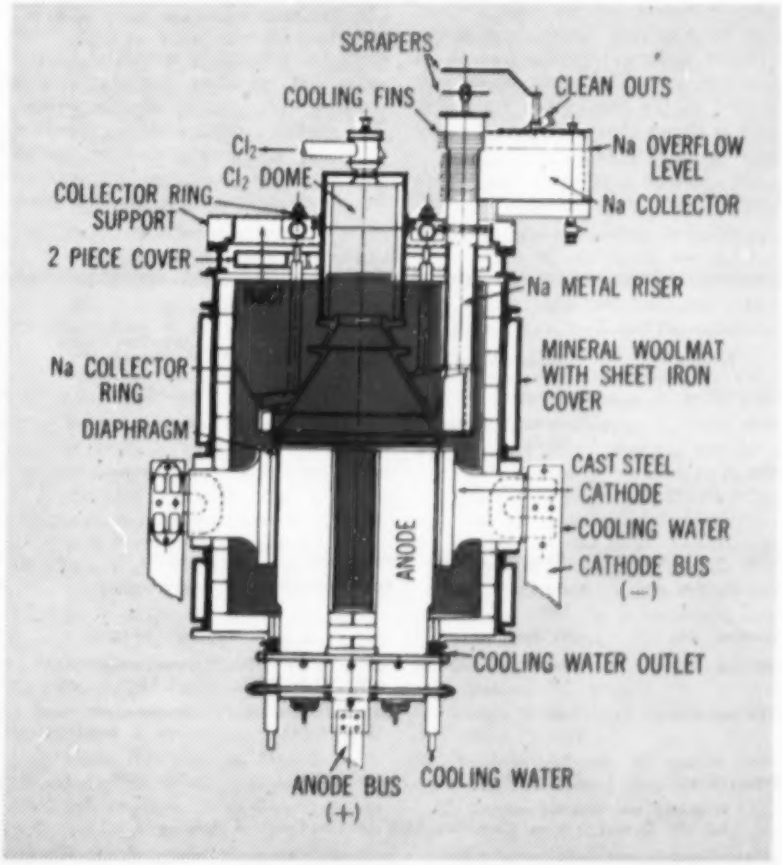
#### Availability of the Alkali Metals

The present availability of each of the alkali metals is adequate to meet present demands. This applies to both the known reserves of ores and to the extent of manufacturing facilities. Steadily increasing demands for each of the alkali metals calls for a steady expansion of known reserves and of manufacturing facilities as well. The raw material pictures for each of the alkali metals indicate adequate supplies of the ores within the United States for the immediate future.

##### LITHIUM METAL

In contrast to sodium and potassium, which are found in nature as relatively pure chloride salts, lithium offers a real problem in extraction from its ores. These ores are low in concentration

Fig. 5. Cross section of sodium cell. Drawing courtesy Dr. C. L. Mantell.



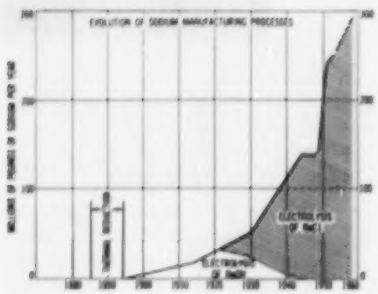


Fig. 1. Evolution of sodium manufacturing processes.

(generally less than 10% $Li_2O$ equivalent) and the deposits are widely separated geographically.

The four main ores of lithium are:

| | | %$Li_2O$ |
|---|---|---|
| 1. spodumene | silicates | 4-7 |
| 2. lepidolite | silicates | 3-4 |
| 3. petalite | silicates | 2-4 |
| 4. amblygonite | a phosphate | 8-9 |

All these are found in pegmatite deposits. Spodumene is a domestic ore whereas the other three materials are largely found in other countries. The statement is made by Norton and Schlegel (*21*) that pegmatite deposits must contain 1% $Li_2O$ in order to be mined profitably.

An important lithium source apart from the four ores listed above is the dilithium sodium phosphate which is recovered from California brines. In contrast to the ores which run 2-9% $Li_2O$ as shown above, these brines may run from 19-21% $Li_2O$.

The lithium resources of North America have been discussed in detail by Norton and Schlegel (*21*) and by Landolt (*18A*). They cover geology, distribution, production, and reserves of lithium ores in the United States and Canada.

Lithium mineral production data over the years are plotted in Figure 7. Lithium resources are usually expressed in terms of $Li_2O$ equivalent content. This lithia content is in turn expressed in units of 20 lb. where one unit represents 1% of one short ton. Lithium mineral production began about 1898 in the United States in the Black Hills of South Dakota. This was the sole United States source until Searles Lake brines were developed as a lithium source in 1938. Then during World War II, spodumene was recovered from deposits in the Kings Mountain district of North Carolina. Since World War II, lepidolite has been imported from Southern Rhodesia.

According to Arundale (*4*) and to Norton and Schlegel (*21*), lithium reserves may be estimated as shown in Table A.

Arundale comments that measured reserves are relatively meager and that anticipated requirements demand the development of more adequate reserves.

The lithium minerals are recovered by one of various techniques:

1. Froth flotation
2. Sink-float separation
3. Hand picking

Once the mineral is recovered from a separation operation, the next step is roasting with either an alkali or an acid. The resulting lithium salt is dissolved in water and precipitated or reacted with other materials to form various lithium compounds. Operations of present U. S. lithium producers are summarized in Table 1. It should be pointed out that for the purposes of lithium metal production it would be most desirable to make the chloride directly from the ore; the carbonate is converted to the chloride in one additional step; manufacture of the chloride from the hydroxide is expensive, requiring conversion to the carbonate in a second process step.

According to Norton and Schlegel (*21*), the mining and concentrating techniques now used at lithium mines involve loss of a significant proportion (perhaps one third) of the lithium values in the ores.

## RAW MATERIALS FOR SODIUM METAL

Sodium, in the form of its various compounds, comprises about 2.6% of the earth's crust, and is the sixth most abundant element there. It occurs primarily as the chloride (halite), the other halides, and in various silicates. Sodium chloride is the principal dissolved constituent of sea water (about 2.8%) and is also widely found throughout the world, both as saturated brine and as deposits of rock salt. The most important sodium salt deposits in the United States are in the New York-Pennsylvania-Ohio area, in Michigan, along the Gulf Coast of Mississippi, Louisiana, and Texas, in Kansas and in the western Virginia-West Virginia area.

## RAW MATERIALS FOR POTASSIUM METAL

Potassium is nearly as abundant as sodium in the earth's crust (2.4 vs.

**Table 1.**

| Producer | Foote Mineral | American Potash | American Lithium Chemicals | Lithium Corp. | Maywood Chemicals |
|---|---|---|---|---|---|
| Raw material | spodumene | $Li_2NaPO_4$ | lepidolite | spodumene | spodumene |
| Mines | Kings Mountain, N.C.; Africa* | Searles Lake, Calif. (brine) | Rhodesia (Africa) | Black Hills, Kings Mountain; Quebec† | Black Hills, S.D. |
| Mills | Sunbright, Va. | Trona, Calif. | San Antonio, Tex. | Hill city and Keystone, S.D.; St. Louis Park, Minn.; Bessemer City, N.C.; Barraute, Quebec† | Maywood, N.J. |
| Initial ore treatment | crushing and grinding | evaporation | crushing | crushing and grinding | crushing |
| Concentration step | heavy-media separation | froth flotation | hand sorting | flotation (S.D.) none (N.C.) | hand picking |
| Roasting step | with limestone | none | with limestone | with $H_2SO_4$ | — |
| Leaching step | water extracts LiOH | $H_2SO_4$ gives $LiSO_4$ + $Na_2SO_4$ + $H_3PO_4$ | water extracts LiOH + KOH | water extracts $LiSO_4$ | — |
| Washing step | none | Sodium carbonate ppts. $Li_2CO_3$ | countercurrent washing & thickening | with lime to give LiOH or carbonation to give $Li_2CO_3$ | — |
| Evaporation | gives LiOH | gives $Li_2CO_3$ | gives LiOH | gives LiOH or $Li_2CO_3$ | — |

* Purchased ore imported
† Actually Quebec Lithium Corp. supplying Lithium Corp. of America

2.6%) and is the seventh most abundant element. Since there is so little potassium in sea water (0.08% KCl) and since potassium is less plentiful in salt deposits, there is a widespread impression that it is much less abundant than it actually is. The most important potassium mineral is sylvite (KCl) and the second in importance is carnallite ($KCl \cdot MgCl_2 \cdot 6H_2O$). Some of the largest potassium deposits of both sylvite and carnallite are those at Stassfurt, in Germany. In the United States, extensive potassium deposits containing sylvite and polyhalite ($K_2SO_4 \cdot MgSO_4 \cdot 2CaSO_4 \cdot 2H_2O$) are located at Searles Lake, California, and at Carlsbad, New Mexico.

### Future Trends

The situation as regards lithium has been neatly summarized by Arundale (*4*). The high solubility of lithium salts in organic solvents such as pyridine and amyl alcohol suggest interesting possibilities for the solvent extraction of lithium from other ions as outlined by Cunningham (*7A*). Basically, however, the problems of concentrating lithium from the ore to the metal will keep it the most expensive of the alkali metals (at a given production volume) and specific and unique uses will have to compensate for this price disadvantage.

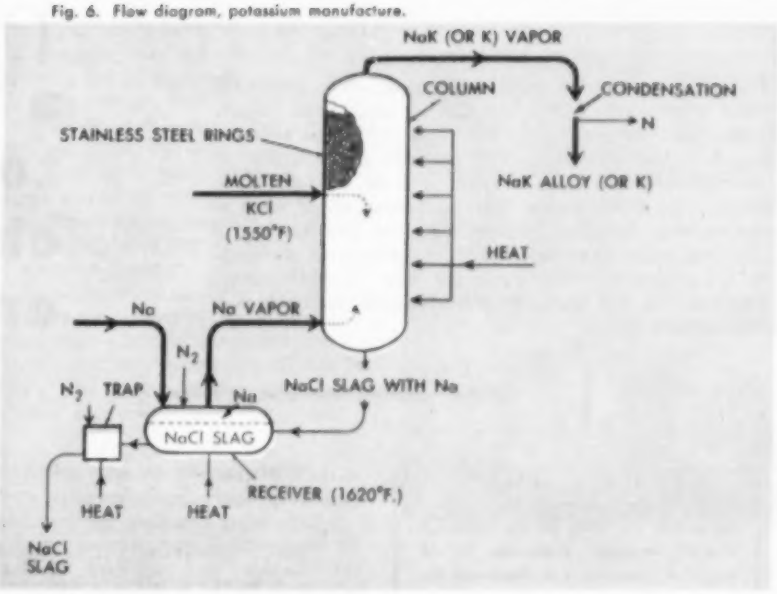
The low price of sodium combined with the increased knowledge of sodium-handling techniques available as a result of atomic energy work has made it a metal of considerable attractiveness to industry. This has resulted in the changeover of the titanium industry from magnesium to sodium as the preferred reducing agent and may result in wider sodium use in other industries.

Potassium uses continue to grow slowly with emphasis on the low-melting sodium-potassium alloy as a useful and versatile heat transfer medium.

**Table A.**

| United States | Units |
|---|---|
| Kings Mountain, N. C. | |
| Known | 4,000,000 |
| Inferred | 124,000,000 |
| Black Hills, S. D. | |
| Known | 1,000,000 |
| Inferred | 400,000 |
| Searles Lake, Calif. | |
| Known | 9,000,000 |
| **Canada** | **Units** |
| Manitoba | |
| Inferred | 2,000,000 |
| Quebec (*3*) | 18,000,000 |

Fig. 6. Flow diagram, potassium manufacture.

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*Presented at A.I.Ch.E. New Orleans Meeting.*

# NITROGEN OXIDES | a challenge to chemical engineers

**Studies of methods of reducing nitrogen oxide concentrations in effluents to the atmosphere have been largely neglected. The purpose of this paper is to urge chemical engineers to investigate the problem of reduction of nitrogen oxides and to develop feasible methods of so doing. The final solution may, of course, entail none of the methods described. Nevertheless, the problem is of a chemical engineering nature and thus presents a challenge to the profession. Pure air is our most valuable natural resource. In this instance, the chemical engineer must help protect it.**

*W. L. Faith* † | Air Pollution Foundation, Los Angeles, California

**The following paper is to be presented September 10, 1956, at the Pittsburgh A.I.Ch.E. meeting. Publication in advance of presentation is convenient for the reader who may wish to prepare comments for oral discussion at the meeting.** ***Editor***

Almost all chemical engineers have heard the old canard that since technological progress has outstripped social progress, we should declare a moratorium on the former and devote our energies to the problems of society. It is obvious, however, that the two are often inseparable and that true progress cannot omit either discipline.

Air pollution offers a good example. A specific instance in this area is the nitrogen oxides problem. Scientists now agree that the most logical explanation of some of the manifestations of Los Angeles smog is a photochemically induced reaction between organic compounds (hydrocarbons and their oxidized derivatives) and nitrogen dioxide in the atmosphere. Both organics and nitrogen oxides (NO and $NO_2$) are found in the air in abnormal quantities on smoggy days. In Los Angeles, values as high as 3 p.p.m. hydrocarbons and 0.7 p.p.m. total NO and $NO_2$ have been found. Laboratory experiments have shown that at these concentrations an oxidant (primarily ozone) is formed when the mixture is subjected to certain wave lengths of sunlight. High oxidant values, up to 1 p.p.m. (calculated as ozone), are formed in the Los Angeles atmosphere during smog attacks. The only known way by which these high oxidant concentrations may be produced in the lower atmosphere is by the photochemical reaction just referred to.

All the other annoying manifestations of smog, that is, eye irritation, vegetation damage, and restricted visibility, may be explained on the same basis. Eye irritation from this reaction has been demonstrated by controlled experiments in large chambers. Typical smog damage to vegetation has been reproduced by the reaction between ozone and olefinic hydrocarbons only. Experience in the gas industry shows that oxides of nitrogen in extremely small quantities will react with hydrocarbons to form particulate matter, even in the dark.

The most probable explanation of the ozone-forming reaction is:

$$NO_2 + h\nu \rightarrow NO_2^*$$
$$NO_2^* \rightarrow NO + O$$
$$O + O_2 \rightarrow O_3$$
$$\text{organics} + NO \rightarrow \text{organic-nitrogen complex}$$

$h\nu$ = quantum of light.
$^*$ = excited state.

The mechanism of the reactions producing eye irritation, plant damage, and reduced visibility is more obscure. Whether or not these effects are the result of the same reaction, simultaneous reactions, or consecutive reactions is presently unknown. The point is that all effects can best be explained on the basis of a reaction between nitrogen oxides and organics.

Nevertheless, the social aspect of smog abatement is so serious that the technological problem of reducing atmospheric concentrations of organics or oxides of nitrogen, or both, should not wait for further elucidation of reaction mechanisms. Mechanism studies are in progress, as are empirical studies, aimed at learning the allowable threshold concentrations of organics and nitrogen oxides that give rise to the distressing manifestations of smog. Considerable work also is under way on methods of reducing hydrocarbons and other organic emissions at their principal sources.

### Sources of Atmospheric Nitrogen Oxides

The primary and almost sole source of nitric oxide (NO) and nitrogen dioxide ($NO_2$) in the atmosphere is the combustion of fuels. In all burning processes, some of the nitrogen in the air is fixed as NO. The amount depends mostly on the temperature level reached during burning, and the rapidity with which the combustion effluents are quenched.

Typical equilibrium concentrations for the reaction

$$N_2 + O_2 \leftrightarrows 2NO$$

are shown in Table A.

Of course, reaction rates at the higher temperatures are extremely rapid; whereas, at room temperature they are almost infinitesimally slow. Obviously, the concentration of nitric oxide in cool combustion gases depends on the rate of cooling of the gases. A secondary influence in the presence of excess oxygen is the rate of oxidation of NO to $NO_2$.

Based on quench rate and amount of excess air, combustion effluents may be divided into two general types:

1. Exhaust from internal-combustion engines (high quench rate and insufficient air for complete combustion).
2. Stack effluents from the burning of fuels in furnaces and boiler plants (lower quench rates and excess air).

Unfortunately, data on the nitrogen oxide content of effluents from commercial engines and power plants are comparatively meager.

### INTERNAL-COMBUSTION ENGINES

Widely quoted data on the total nitrogen oxide content of auto exhaust (*1*) are recapitulated in Table 1. Unpub-

† The author is vice-president and chief engineer of Air Pollution Foundation.

Table A

**Equilibrium Concentrations**

| Temperature ° C. | NO Concentration (p.p.m.) |
|---|---|
| 20 | <0.001 |
| 427 | 0.3 |
| 527 | 2.0 |
| 1,538 | 3,700. |
| 2,200 | 25,000. |

lished data obtained in automotive and petroleum industry laboratories indicate that the value shown for acceleration may be higher than that obtained in average city driving by as much as 100 per cent. On the other hand, there is general agreement that cruise values are of the proper order of magnitude and that only emissions during acceleration and cruise are significant in the air pollution problem. One must realize, however, that although values of oxides of nitrogen are calculated as nitrogen dioxide, the major component by far is nitric oxide. Conversion to nitrogen dioxide in the exhaust system is probably relatively minor.

### POWER PLANT STACKS

The nitrogen oxide content of stationary fuel-burning equipment varies greatly from one installation to another. As with internal-combustion engines, this is considered a function of flame temperature and quench rate. Almost all data, however, have been related to the fuel burned.

Hall (*2*) shows values (calculated as $NO_2$) obtained from the burning of natural gas in a wide variety of equipment from kitchen ranges to "high fire" steam boilers (See Table 2).

Similar studies made by Stanford Research Institute gave a general figure of 14 lb. $NO_2$/ton natural gas. The Los Angeles Control District currently uses a value of 16 lb./ton gas burned (37 lb./100 million B.t.u.).

Data on units burning fuel oil show less agreement among investigators, probably because of the small number of measurements made. Stanford Research Institute data indicate 27 lb./ton of fuel oil burned; the Control District uses a value of 34 lb./ton. Recently, the Western Oil and Gas Association made a survey of six refineries in the Los Angeles Basin. This survey covered a larger number and wider variety of stacks than have ever been reported. Oxides of nitrogen emissions, calculated as $NO_2$, indicated 50 lb./100 million B.t.u. (20 lb./ton) of fuel oil and 15 lb./100 million B.t.u. (6.5 lb./ton) gas. It is difficult to reconcile these lower values with others reported, except on the assumption that previous values have been based on too few analyses. Similarly, the differences in the amount of nitrogen fixed between oil and gas burning can be explained only by differences in average flame temperatures and furnace design. It is not believed to be related to the nitrogen content of the fuel, because if the nitrogen in the fuel were converted to oxides of nitrogen, the effluent values would be of the order of 100 lb./ton of fuel oil burned.

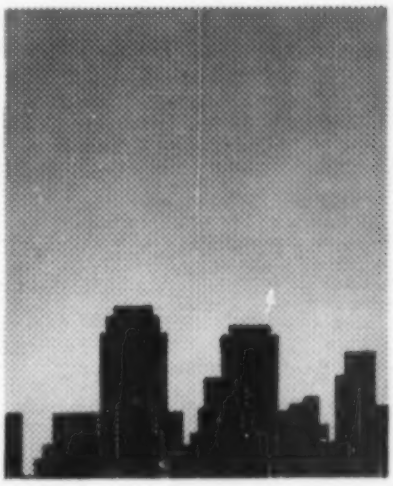
One explanation might be in the analytical method used, the phenol-disulfonic acid method (*3*). This method, the most reliable chemical method known, not only measures total NO and $NO_2$, but also measures nitrates and certain organic nitrogen compounds.

### Reducing Nitrogen Oxide Emissions

Regardless of discrepancies in analyses of combustion effluents for oxides of nitrogen, two facts remain. They are:

**1. The high oxides of nitrogen content of urban atmospheres (specifically Los Angeles) is derived from combustion effluents (65 to 85% from burning gasoline in automobiles; 15 to 35% from gas and fuel burning).**

**2. To eliminate or alleviate the annoying manifestations of Los Angeles smog, these emissions probably must be curtailed. Since these emissions are the result of a chemical reaction, chemical engineers are the obvious group to come up with a solution. Several methods of attack have been proposed.**



### DECOMPOSITION OF NO

Since nitric oxide is unstable with respect to its elements at ordinary temperatures, one approach might be its catalytic decomposition. This is particularly attractive because the reaction is of zero order below 1,000° C. With an active catalyst, short contact times might be effective at the point where combustion gases leave the cylinders of internal-combustion engines, or where they

**Table 1.—Results of a Typical Analysis of Automobile Exhaust Gases**

| | Idling | Acceleration | Cruising | Deceleration |
|---|---|---|---|---|
| Hydrocarbons ($C_3 - C_9$), as hexane, p.p.m. | 1275 | 410 | 354 | 5125 |
| Acetylenic, as acetylene, p.p.m. | 825 | 18 | 64 | 687 |
| Oxides of nitrogen, as $NO_2$, p.p.m. | II | 4180 | 1606 | 18 |
| Lower aldehydes, as formaldehyde, p.p.m. | III | 1269 | 264 | 193 |
| CO % | 3.6 | 0.0 | 0.4 | 1.5 |
| $CO_2$ % | 10.0 | 13.7 | 12.9 | 6.1 |
| $O_2$ % | 1.4 | 1.3 | 1.1 | 9.5 |

Data published by Los Angeles County Air Pollution Control District.

**Table 2.—Trace Components in Products of Combustion from Domestic Gas Appliances Using Natural Gas**

| | Oxides of Nitrogen (as $NO_2$) | | |
|---|---|---|---|
| | p.p.m. | lb./ton gas | lb./100 million B.t.u. |
| Bunsen burner | 21 | 3.0 | 7.0 |
| Range-top burners | 22 | 1.3 | 3.0 |
| Range oven | 15 | 2.0 | 5.0 |
| Water heater, 20 gal. | 25 | 2.0 | 5.0 |
| Water heater, 100 gal. | 45 | 4.0 | 9.0 |
| Floor furnace | 30 | 3.0 | 7.0 |
| Forced-air furnace | 50 | 4.0 | 9.0 |
| Steam boiler, 10 million B.t.u./hr. | | | |
| Low fire | 40 | 6.0 | 14.0 |
| High fire | 90 | 7.0 | 16.0 |

enter the superheater section of a boiler plant. Under the latter conditions, the equilibrium concentration of nitric oxide is quite low, but the temperature is sufficient for an adequate reaction rate. There is also the possibility of combining a nitric oxide decomposer with catalytic converters designed to burn residual organics in an auto exhaust system. Two birds might be killed with one stone.

### CHEMICAL REDUCTION OF NO

Another attractive approach is the catalytic reduction of NO. Possible reactions are:

$$2NO + 2H_2 \rightarrow N_2 + 2H_2O \quad (1)$$

$$2NO + 2CO \rightarrow N_2 + 2CO_2 \quad (2)$$

$$CH_4 + H_2O \rightarrow CO + 3H_2 \quad (3)$$

followed by (1) or (2)

$$6NO + 4NH_3 \rightarrow 5N_2 + 6H_2O \quad (4)$$

Hydrogen, carbon monoxide, and methane are all present in auto exhaust; ammonia is a comparatively cheap reagent.

One nitric acid manufacturer utilizes a catalytic reduction to decrease oxides of nitrogen concentration in the off-gases from a nitric acid plant. Because the catalyst used is oxygen-sensitive, excess natural gas is added to the effluent to burn out the oxygen. The hot gases are then passed over a catalyst of undisclosed composition. Whether the reducing agent is methane, carbon monoxide, or hydrogen is not known, but the operation is sufficiently effective to reduce nitrogen oxides from several hundred to less than 10 parts per million.

No data are available on the $NH_3$-NO reaction, but interference by $SO_2$ must not be overlooked.

### REMOVAL OF $NO_2$

If the various methods of NO reduction are not suitable, there is always the possibility of rapid oxidation of NO to $NO_2$, followed by removal of the latter. Two analytical instruments are available in which NO is oxidized rapidly and completely to $NO_2$, which is then absorbed in a chemical reagent. In one of these (*4*) ozone is added to the gas stream to oxidize the NO; in the other (*5*) the oxidation reaction is accelerated by adding 1,3-butadiene as a catalyst. Similar methods might be applicable to stack gases, but absorption of the resulting $NO_2$ would still be required. Unless the absorption rate of the solution and its capacity are extremely high, the method will not be economically attractive.

### Inhibition of NO Formation

Many gas-phase reactions may be inhibited by exceedingly small amounts of contaminants. Whether or not the addition of such material to the fuel would inhibit high-temperature nitrogen fixation is not known. On the other hand, tetraethyl lead was adapted to a similarly "difficult" reaction.

### Literature Cited


1. Los Angeles County Air Pollution Control District, "Automobile Exhaust Testing Procedures and Efficiency Studies in the Evaluation of a Catalytic Muffler," Los Angeles (July 1954).
2. Hall, Edwin L., Proc. Second National Air Pollution Symposium, pages 84-89 (1952).
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4. Borman Engineering Company, No. Hollywood, California.
5. Rubicon Company, Philadelphia, Pennsylvania.

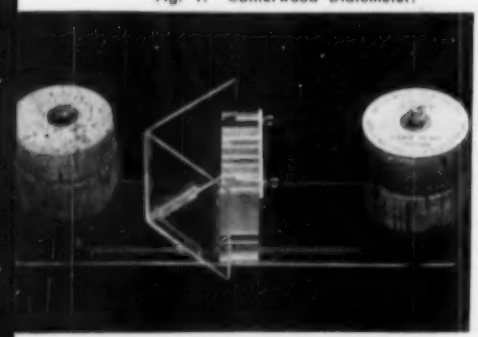

## techniques

# NEW TECHNIQUE SIMPLIFIES STREAM POLLUTION MEASUREMENT

**"Diatometer" method developed by Philadelphia Academy of Natural Sciences used in Sabine River tests.**

As part of a program aimed at minimizing pollution at its Sabine River plant near Orange, Texas, Du Pont called in experts from the Academy of Natural Sciences of Philadelphia to make a complete survey of the health of the river. The pollution problem was posed by the plant's use of from 50 to 100 thousand gallons per minute of river water, most of which is returned to the stream after use. Pollution surveys were therefore carried out in 1952 and 1953, and included detailed studies of all types of plant and animal life, from algae to fish.

Fig. 1. Catherwood Diatometer.



### Measurement Method

Diatoms are single cell plants which fall near the bottom of the food chain and which constitute an element essential to animal life in the river. The distribution of diatom species and the relative population of these species have been established by the Academy of Natural Sciences to be indicative of the distribution of the higher forms of plant and animal life in the region of the sampling station. Hence, a careful study of the diatom population in a stream affords a reliable criterion of the water's ability to support aquatic life.

### Testing Technique

Plant personnel collect representative samples of diatoms from several sampling stations in the river using Catherwood Diatometers. These are simply floating devices designed to suspend conventional microscope slides in the flowing stream. A typical diatometer assembled with cork floats and a plastic hull is shown in Figure 1. With time, large numbers of diatoms accumulate on the slides. At two-week intervals, the slides are removed and forwarded to the Academy for examination.

### Results

Guided by this measurement technique, effectiveness of pollution control at the Sabine River Works has increased steadily. The B.O.D. (biological oxygen demand) of the plant effluent is now only one third of its value at the time of the first complete river survey in 1952.

*Condensed from a paper "Stream Health Maintenance in Coastal Regions," by W. F. Brandyke, E. I. du Pont de Nemours and Company, presented at Louisiana State University, February 22, 1956.*

# SOLID FORM HYDROCARBONS PIPELINED TO COLORADO REFINERY

**Resourceful integration of modern mining and chemical processing techniques by American Gilsonite Company will move an estimated 16 million tons of Gilsonite deposits from inaccessible Utah mountain area to Colorado processing plant.**

• *Raw material:* Gilsonite is an asphaltite with high resin content, little sulfur. Has been mined on limited scale for marketing unprocessed for asphalt floor tile, storage battery boxes, inks, paints, varnishes, and insulation for hot underground piping.

• *Occurrence:* In vertical veins varying from a few inches to a maximum of 24 feet in width, 800 to 1,700 feet in depth and sometimes several miles long.

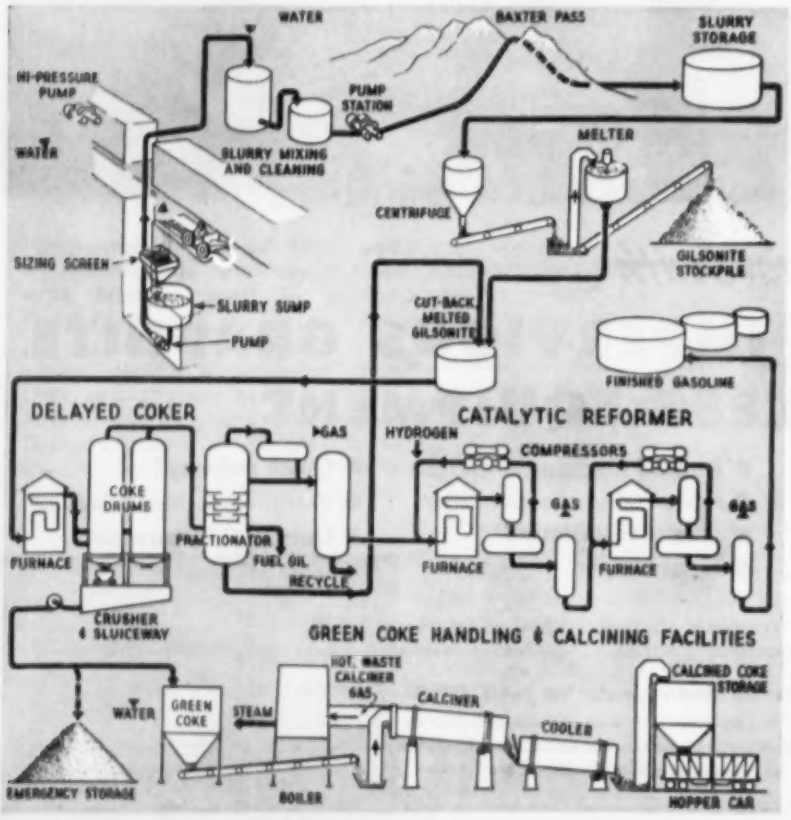
• *Problems:* 1—The mining operation itself; 2—transporting the ore to the refinery; 3—processing method to turn all chemical components of the material into salable products.



### Mining Methods

Gilsonite ore is friable, and in underground operations the fine dust constitutes a serious explosion hazard. American Gilsonite plans to sink a shaft to at least 850 feet, then dig drifts or tunnels into the vein by means of air-operated jet cutting cars. Two types of cutting heads will be used: for the more friable material, high pressure water will be used to break out the ore; for more solid ore, a rotary drill armed with carbide-tipped teeth will be employed. In either case, additional jets of low pressure water will wash the mined ore down the slightly sloping drifts into a sump at the bottom of the main shaft.

After a screening operation, large lumps of ore will be hoisted to the surface with conventional hoists while the fines will be pumped to the surface as a water slurry with centrifugal pumps. At the surface the slurry will be prepared in the proper pumping proportion and cleaned to drop out sand, rock and other tramp material. It will then be stored in agitated tanks which feed into the pipe line.




Flow diagram of the Gilsonite coking project, embracing the mining operations at Bonanza, Utah, and the refining operations at Gilsonite, Colorado.

### Long Distance Pipe Line

Decision to move the mined ore from the Bonanza, Utah, mine to the treating plant at Gilsonite, Colorado (near Grand Junction), by pipe line was dictated by the rail facilities, the nearby gasoline market, and the fact that Gilsonite is the shortest pipe line distance from the mine. The slurried ore will be carried over a mountain pass at 8,492 feet elevation to the refinery site 70 miles away. To eliminate danger of freezing, the pipe line will be buried beneath the frostline, and where it crosses two suspension bridges 600 and 700 feet long, will be insulated.

Extraordinary precautions will be taken to avoid plugging in case of a forced shut-down of the line. One standby electric pump will be installed at the single pumping station. In addition, the diesel-driven pump, which normally supplies water for jet mining, will be available at all times to take over the pipe line service in case of power failure. As a last-ditch measure, a water reservoir with a remote-controlled valve system will be installed at the highest point of the line to flush the slurry out in both directions if necessary.

The pilot model of the pipe line used a unique method to test corrosion: a radioactive section of pipe was inserted in the line, and by measuring the activity of the effluent slurry, accurate corrosion data was obtained. As a result of these tests on the pilot model, it was found that the addition of small amounts of sodium sulfite to remove free oxygen would almost eliminate corrosion.

In the full-scale operation, the line will be 6-in. pipe and the flow rate will range from 200 to 500 gallons of slurry per minute.

### Processing

Several years of development and pilot plant work have gone into a process which will produce a high grade electrode coke and a high-octane gasoline from the Gilsonite ore. The planned $16 million refining plant in Colorado

(*Continued on page 37*)


# "Still glad you came to work for Pritchard, Howard?"

"I'm more pleased than ever—if that's possible. You know what happened today, up in the chemical division?"

"What?"

"We wrapped up the plans for a dry ice plant. It's going to be a beauty when we get it built. I've never seen such teamwork before."

"What do you mean by 'teamwork,' Howard?"

"The way the designers and engineers all work together toward the same goal. It's all a matter of cooperation. Each group that works on the project, is a specialist in its own field and all work closely with the client's own personnel."

"That's the way it has to be, Howard. We learned that philosophy many years ago. Experience and knowledge are only as good as the cooperation that goes into putting them together."

"That's another thing that amazes me. The knowledge our people possess. It doesn't make a bit of difference what kind of facilities our clients want—fractional distillation, absorption, evaporation, crystallization, filtration, heat transfer, our people know how to build it."

"I know how you feel. I went through it myself twenty years ago when I started out at Pritchard. It's a great feeling, too! Can I give you a ride home?"

**J. F. PRITCHARD & CO.**
**4625 Roanoke Parkway, Kansas City 12, Mo.**

## GILSONITE PROCESSING

(*Continued from page 34*)

is expected to produce 1,300 bbls./day of gasoline, 300 bbls. of fuel oil, and 250 tons of calcined metallurgical coke. The coke will be shipped by rail to metallurgical operations chiefly in the Northwest, and the gasoline will be marketed locally in the Colorado area.

At the refining facility, the slurried ore will first be dewatered, then melted at about 450° F. (well above its melting point) by heat from the delayed coker. Other recycle streams will be added at this point.

From this point on, the process differs only in details from standard coking and refining operations—once the Gilsonite has been melted, it is, in effect, crude oil.

### Coking and Refining

Combined feed to the plant, consisting of 7,700 bbls. of recycle and 3,850 bbls. of melted Gilsonite, will be pumped into a direct-fired horizontal updraft heater operating at 910° F. The heater will discharge into a conventional coke drum where the vapor will be separated from the liquid and the coke precipitated.

The vapors and gases will pass into the fractionator. Here certain vapors will be separated and condensed to become recycle streams. A gas oil fraction will be withdrawn and charged to a thermal cracking furnace operating at a temperature of 985° F. After cracking, the vapor-liquid mixture will re-enter the fractionating column where it will be separated into gas, gasoline, recycle stock and cracked tar. Tar will be recycled through the delayed coking section.

The vapor mixture will be split into wet gas and unstabilized gasoline in a low-pressure separator, followed by high-pressure separation. Desired low-boiling fractions in the gas will be absorbed by a lean absorption oil fraction and returned to the fractionator. The unstabilized gasoline will go to the stabilizer, where hot stabilized gasoline of pre-determined vapor pressure will be produced.

The first section of the reformer generates hydrogen for addition to the raw gasoline being supplied from the delayed coker to the second section of the catalytic reformer. This hydrogen combines with the nitrogen compounds in the raw gasoline and removes them as ammonia gas.

The raw material will be converted into finished gasoline in the third section of the reformer. Here propane and butane will also be produced and returned to the hydrogen generation section.

Green coke from the coke drums will be calcined in a rotating kiln which will be followed by a rotary cooler. Waste gas from the calciner will be burned to generate steam. Gases from other units of the refinery will be used as furnace fuel and as fuel for driving compressors.

## NEW $20 MILLION OIL REFINERY PLANNED FOR NEW ORLEANS AREA

**Chemoil Corporation's 20,000 B/D installation planned to get underway within twelve months.**

A new petroleum refinery will be built in the greater New Orleans metropolitan area, according to plans announced by J. R. Tusson, president of Chemoil Corporation, a firm newly organized for this purpose. Plans include a tentative onstream date 30 to 36 months away, with builder to be named shortly. A prospectus has been issued by the company and approved by the Louisiana securities commissioner for an initial stock issue of $2 million. This represents only a portion of the capital requirement, the balance coming from other sources as yet unnamed.

### Plant Location

Site of the new facility is so far defined as "within the New Orleans-Baton Rouge industrial complex."

The company's site requirements have been dictated by several factors: a surplus of crude and a shortage of refining capacity in the area, transportation factors (both foreign and domestic), and the wish to attract satellite chemical industries to share its expected 600 to 1,000 acres. Louisiana now has 250 thousand bbls./day of oil shut in, a discovery rate of 15 thousand bbl./day., and is operating on an allowable removal rate of 39% of the March 1953 production level.

### Products

The refinery will be of the latest design and will be built for maximum flexibility in order to supply an expected demand for particular petrochemical intermediates such as ethylene and propylene. The gasoline pool will be able to supply, according to demand, from regular to high octane.

## HIGH ENERGY CHEMICAL FUEL FOR AIR FORCE TO BE PRODUCED BY OLIN MATHIESON

**New plant near Niagara Falls to cost approximately $36,000,000.**

A new multimillion dollar plant at the Lake Ontario Ordnance Works in Model City, N. Y., will turn out high energy chemical fuel for use in missiles and aircraft engines. The plant is said to represent the culmination of experimental and development work carried on by Olin Mathieson for the Department of Defense since 1952.

Announced also were plans to build a smaller plant at the same location to produce the same fuel for the Navy. It is understood that contracts for the design of these facilities have been awarded to Singmaster & Breyer.

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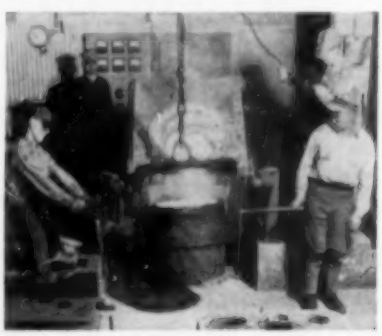
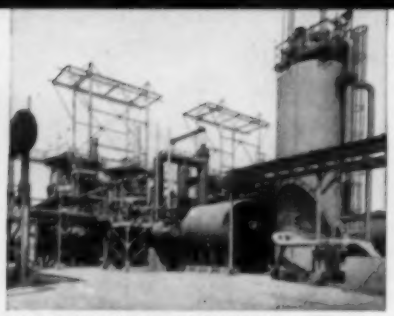
**Major ethylene glycol plant, to cost $28,500,000, will be built by Union Carbide in Puerto Rico.** The company has applied for tax exemption under Puerto Rico's Industrial Incentive Act, expects to complete the plant two years after exemption is granted, or about July, 1958. The plant will be built on one of several sites adjacent to the Ponce refinery of Commonwealth Oil Refining Company which will supply the raw materials. □

**A $3.4 million chemical manufacturing plant will be built for Eli Lilly & Co. at its Tippecanoe Laboratories** near Lafayette, Ind. The new facilities, scheduled for completion late in 1957, will increase the company's chemical capacity by some 50%. Included are two general chemical manufacturing units and three diethylstilbestrol units. □



As part of its continuing modernization program, Empire Steel Castings, Reading, Pa., has just installed this new $85,000 Ajax induction melting furnace which will enable the foundry to increase its line of corrosion resistant steel castings. Quick customer service will also result since the company can now handle small specialized heats promptly.

**A CONSTANT SEARCH** for new and better catalysts is carried out by Girdler's Research and Development Service. Typical of the work of this branch is the constant testing (above) for the proper balance between physical strength and activity of catalysts.



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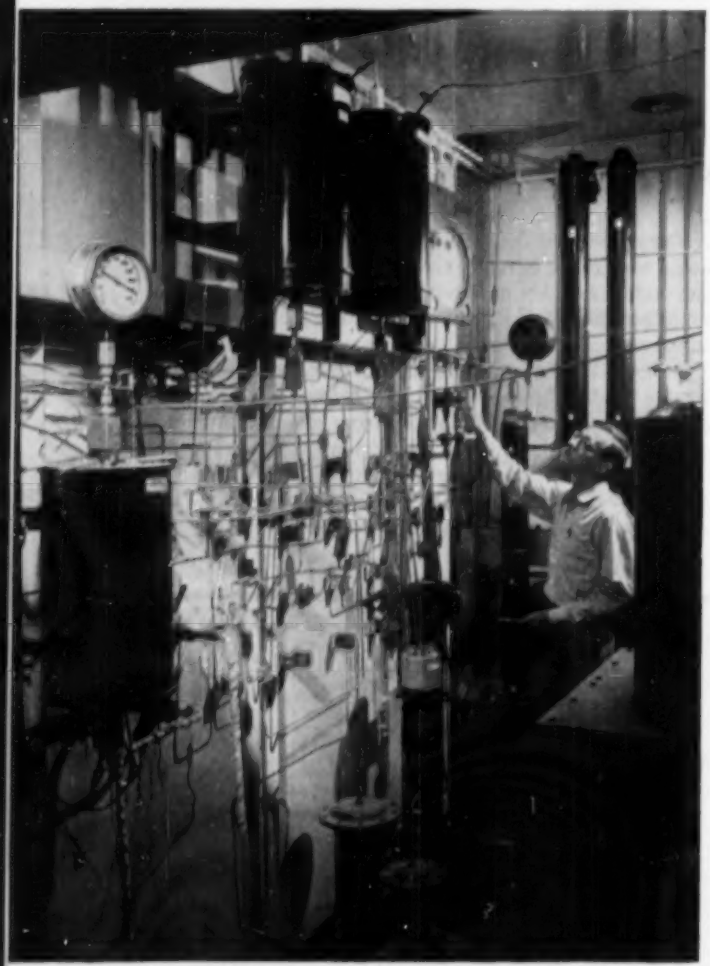

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| 26A | 27R | 28A | 29A | 30A | 32A | 304A | 33A | 35A | 36A | 38L |
| 39A | 40A | 47A | 48A | 50L | 51A | 52L | 53A | 54L | 55A | 58L |
| 59A | 60L | 61A | 62L | 63A | 64L | 65A | 66L | 67R | 68L | 69A |
| 70L | 71A | 72TL | 72BL | 72BR | 73R | 74L | 75R | 77A | 78L | 78R |
| 79R | 81A | 82L | 82R | 83R | 84L | 85TR | 85BR | 86TL | 86BL | 87L |
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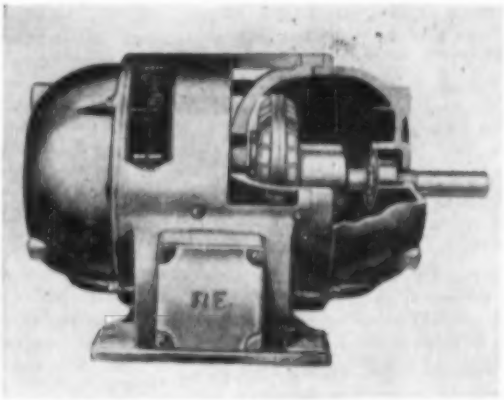
## developments of the month—



**54 Dry Fluid Coupling.** A new fluid drive principle is embodied in the "Flexi-Shaft" motor being turned out by the Reuland Electric Co. Steel shot is used in the coupling instead of a true fluid.

The dry-fluid coupling is an adaptation of the new Dodge Flexidyne drive. Its operating principle is based on centrifugal force throwing the steel shot to the perimeter of the housing. The housing, in turn, is keyed to the load & accelerates as the rotor gradually becomes "imbedded" in the tightly packed shot.

Primary features are said to be smooth load acceleration, protection against equipment jamming, & the ability to start heavy loads on lower actual operating horsepower.

Flexi-Shaft motors are produced in ratings from ½ through 15 hp.

(Continued on page 42)

◀ TURN THIS PAGE TO RIGHT FOR MORE . . .

◀ HOW TO USE THIS POST CARD FOLDER

**Merely encircle numbers on cards to get literature desired. On advertised products in front of magazine, fold this page out to right. For those in back, fold card strip again to right, where card strip is scored for detaching.**

# products-

## advertised in this issue

**IFC Urea Process.** Built by Vulcan-Cincinnati, Inc., the first Invento-Vulcan urea plant is on stream in the U. S. Corrosion was conspicuously absent as were clogged lines & contaminated product. Details available.

**3R Vibrating Packer.** ViBrox Barrel & Drum Packer, made by B. F. Gump Co., uses rocking-vibrating motion to pack more material in drum or barrel. Continuous operation cuts time and labor.

**4A Plant Design.** Catalytic Construction Co. offers top flight design & engineering services to metallurgical, petroleum, chemical & petrochemical industries.

**6A Process Tubing.** Babcock & Wilcox Co. make all types of process heater tubing for the oil refining & petrochemical industries. Maximum corrosion resistance under unusual temperature & pressure conditions.

**7A Controlled Volume Pump.** Lapp Pulsafeeder is a combination piston-diaphragm pump for controlled volume pumping. No stuffing box or running seal. Bulletin available from Lapp Insulator Co., Inc.

**8A Heavy Duty Compressors.** Illustrated brochures describing installations of large Ingersoll-Rand compressors.

**10L Braided Packing.** Criss Cross braided packing, made by U. S. Gasket Belmont Packing, offers 'locked in' lubrication and controlled porosity.

**11A Continuous Reactors.** Rapid heat transfer rate is feature of Votator continuous reactors manufactured by Girdler. Suggested applications are sulfonation, sulfation, nitration, saponification. Data on request.

**12A Valves and Fittings.** All types of valves for refinery service. Sizes up to 24 inch, pressures to 2,500 psi. Crane Co.

**13A Ammonia Plants.** Foster Wheeler design, engineering & construction 'know-how' go into the building of Casale process ammonia synthesis plants.

**14L Alloy Castings.** The Duraloy Co. is equipped to turn out sound, correctly-alloyed castings from a few ounces in weight up to many tons.

**15A Filtration.** For any filtration problem, Eimco Corp. will provide consulting services based on more than fifty years of experience.

**16A Horizontal Processing Units.** This type of unit, designed by Bethlehem Foundry & Machine Co., offers many advantages in processing of high consistency materials, drying of solids, etc.

**17A Carbon Products.** Electrodes, anodes, carbon brick & mold stock of superior quality are products of Great Lakes Carbon Corp.

**18L Lubricators.** Manzel lubricators assure positive force feed lubrication at pressures up to 30,000 psig. Houdaille Industries, Inc.

**19A Limestone.** Pure limestone (more than 97.8% calcium carbonate) is available in large quantities. Further information furnished by Norfolk and Western Railway.

**20L Filter Presses.** Complete range of styles & sizes for every filtration need. Catalog from D. R. Sperry & Co.

**21A Teflon.** All types of gaskets & packings are manufactured of Du Pont Teflon. Suitable for handling of fluids at high temperatures & pressures. Complete property & application data available.

**22A Concentrators.** Buflovak Roto-vak concentrator employs single pass, downflow principle, plus positive agitation. Concentration to higher densities than in conventional equipment. Blaw-Knox Co.

**23A Plant Design & Construction.** The Lummus Co. has placed in operation the first full-scale commercial plant in this country for the production of acetylene chemicals by high-pressure techniques.

**24L Cementable Teflon.** New Teflon lining can be bonded to wood, glass, metal or other surfaces. Available in rolls or sheets. Garlock Packing Co.

**25A Gyratory Screen.** New stainless steel gyratory screen offered by Allis-Chalmers gives top efficiency & maximum capacity. Descriptive bulletin.

**26A Chemical Feed Systems.** Bulletins describing the use of controlled volume pumps in paper making, industrial water treating & process instrumentation. Milton Roy Co.

**27R Rubber Linings.** Almost any size or shape of special processing equipment can be lined with quality Ace hard or soft rubber. Eleven basic materials, wide range of temperatures, pressures, strength. American Hard Rubber Co.

**28A Valve Manifolds.** Automatic protection assured for differential pressure type instruments. Equa-safe manifolds are manufactured by Republic Flow Meters Co.

**29A Distillation Equipment.** Advanced design of facilities for fats & oil extraction, fractionation, distillation & refining are offered by Blaw-Knox Co.

**30A Crystallizer.** Conkey Crystallizers are engineered and designed to cut installation costs and reduce operating costs to a minimum. Fabricated and erected by Chicago Bridge & Iron Co.

**32A Plant Construction.** Graver Construction Co. has more than 20 years' experience in the construction of complete refineries, chemical plants, steel mills, etc.

**304A Tower Packing.** Intalox saddles have been demonstrated to be more efficient than Raschig rings. 16-page booklet from United States Stoneware Co. gives comparative charts showing relative pressure drops, flooding limits, gas pumping costs, etc.

**33A Karbate Equipment.** Karbate brand impervious graphite offers many advantages, including lower first cost, low maintenance, immunity to thermal shock & high thermal conductivity. National Carbon Co.

**35A Dowtherm.** Eliminate off colors & spoiled batches. Increase resin & drying-oil quality by using precise uniform process heating with Dowtherm. Dow Chemical Co.

**36A Plant Design and Construction.** J. F. Pritchard & Co. are designers & construction engineers for the gas, power, petroleum & chemical industries.

**38L Swivel Joints.** Emsco swivel joint breaks like a pipe union. Packing is then readily accessible & easily replaced. Manufactured in all popular sizes for practically every type of service. Emsco Manufacturing Co.

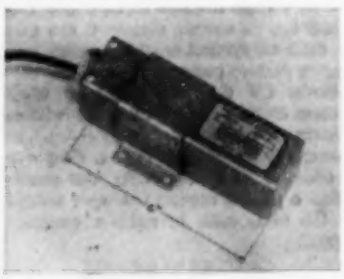
**39A Filter Aids.** Dicalite Filteraids, product of the Great Lakes Carbon Corp., afford a wide range of filter throughput. Consulting services available.

**40A Catalyst Service.** Girdler offers application, development, analytical & market research services in connection with the employment of Girdler catalysts. Free booklet on request.

**47A Grinding Machines.** Sturtevant Micronizer grinding machines give greater fineness than tube or roller mills. Catalogs on this & other dry processing equipment. Sturtevant Mill Co.

## DEVELOPMENTS OF THE MONTH *(Continued)*

**55 Proximity Switch.** Minneapolis-Honeywell engineers have developed a new switch which works like a "magnetic detective" to locate objects containing iron on assembly lines, in liquids, & in finely-divided non-ferrous solids.



The switch has no moving parts. No physical contact with the work is required; detection is accomplished by the passing of the object through a magnetic field set up directly in front of the switch's sensing end. A signal flows through the magnetic circuitry of the switch & operates a remotely-located electrical control relay. This relay can be triggered up to 10 times per second.

New switch is 6-in. long and 1⅛-in. square & is sheathed in a heavy steel housing. The magnetic circuitry is embedded in a solid plastic solution. It operates on 115 volt, 60 cycle current.

Primary use is expected to be the control of assembly-line operations & allied applications of automation.

(Continued on page 43)

## DEVELOPMENTS OF THE MONTH *(Continued)*

**48A Filter Aids.** Celite filter aids manufactured by Johns-Manville assure efficient & economical filtration under any processing conditions.

**50L Aero Heat Exchangers.** Niagara "Balanced Wet Bulb" control method automatically varies cooling effect proportionately to the load, holds distillation product uniform regardless of climatic conditions. Niagara Blower Co.

**51A Glass-Lined Equipment.** Pfaudler glassed steel equipment carries a full year's guarantee against corrosion. 1956 Buyer's Guide available from The Pfaudler Co.

**52L Metal Hose.** Designed, engineered & manufactured to absorb the beating given your pipe system is seamless flexible metal hose from Packless Metal Hose, Inc.

**53A Molybdenum Catalysts.** Cobalt molybdate catalysts are specially fabricated to resist poisoning by sulfur, nitrogen & metallic contaminants. Bulletin from Climax Molybdenum Co.

**54L Strainers.** Elliott Co. offers bulletin giving data on complete line of strainers including single, twin & self-cleaning types, covering pipe sizes from 1-in. to 24-in.

**55A Filters.** Filters from Process Filters, Inc., insure efficient, trouble-free, high production.

**58L Process Equipment.** Process tanks, units for fume removal & other corrosion resistant items are supplied by Haveg Industries, Inc.

**59A Dryers.** Many wet-solid materials may now be dried efficiently because of drying ranges in equipment by Proctor & Schwartz, Inc.

**60L Pressure Valve.** Pressure relief valves built to last & designed for industrial, power plant & marine applications. From Foster Engineering Co.

**61A Pipe Line Filters.** Staynew filters have a double action principle. Descriptive bulletin from Dollinger Corp.

**62L Evaporator.** Calendria-type evaporators are built by Goslin-Birmingham Mfg. Co., Inc. Consultation without obligation.

**63A Conveyor Elevator System.** Typical arrangements of the Redler loop boot vertical & horizontal conveyors available in illustrated bulletins. Stephens-Adamson Mfg. Co.

**65A Photochemical Equipment.** Photosensitization, a brochure from Hanovia Chemical & Mfg. Co., is a review detailing facts on all phases of the subject plus information on available equipment.


**56 TRANSITE PRESSURE PIPE INSTALLATION** for overhead industrial water & process lines is covered in a new 48-page guide from Johns-Manville. Divided into 15 sections, text covers such subjects as: hanging and supporting the pipe, bracing for thrusts, the poured flange coupling, and the Roto-split flange coupling. Diagrams of typical Transite systems for overhead lines are included. Additional feature is a listing of suppliers of fittings, accessories and couplings. In convenient 4½" x 8" size, guide's rounded corners make it easy to carry and use; ring binding to lay flat on desk or table; more than 50 illustrations.

(Cont. on page 44)

**Numbers without letters indicate data available as described in Data Service "Briefs." Numbers with letters refer to further data concerning products advertised in this issue. Letters indicate position of advertisement on page (if more than one on a page)—L, left; R, right; T, top; B, bottom; A indicates full page; IFC, IBC, and OBC are cover advertisements.**

# products-

## advertised in this issue

**66L Condenser Accessories.** Conseco Flowrites, short molded nylon or metal tubes, are inserted in the entrance end of condenser tubes to prevent erosion. Also coils for feed water heating, heaters & evaporators, cleaning guns and plugs, etc. Condenser Service & Engineering Co.

**67R Heat Exchanger.** Aerofin Corp. manufactures heat exchangers exclusively, offers high efficiency, long service life, low maintenance costs, & services of skilled engineering staff.

**68L Steel Fabrication.** Downingtown Iron Works offers bulletin describing their facilities for the fabrication of heat exchangers and other types of steel and alloy plate fabrication.

**69A Level Control Pilot.** Leslie Co. float-less level control pilots sense changes in liquid level to help maintain peak output, save maintenance dollars. Low resolution sensitivity assures smooth throttling action & closely held level. For storage tank, boiler level & open & closed vessel service.

**70L Pumps.** Aldrich Pump Co. has standard units or modifications for all pumping problems. Data sheet available.

**71A Lead Shielding.** National Lead Co. has an improved casting process which permits void-free shielding of heavy water filters.

**72TL Rotary Pumps.** Eco Engineering Co. All-Chem pumps have capacities 1 to 10 gal./min.; pressures to 150 lb./sq.in. Available from stock, they handle hazardous fluids with dependability.

**72BL Spray Nozzles.** Properly engineered spray nozzles can make a difference in both commonplace & complex problems. Catalog. Spraying Systems Co.

**72BR Process Units.** Schutte and Koerting's Bulletin 16H covers pumping, heating, & straining units.

**73R Scrubbers.** Maurice A. Knight specializes in fume washers (wet contact scrubbers). Working surace is Berl saddle packing, providing maximum surface area & minimum pressure drop. Bulletin No. 9.

**74L Tantalum.** Fansteel Metallurgical Corp. engineers will advise on applications where tantalum's strength, heat transfer qualities & corrosion resistance may be the answer.

**75R Filters.** Complete filtration engineering service from fluid analysis to installation is available from Industrial Filter & Pump Mfg. Co.

**77A Centrifugals.** No matter what you process, De Laval Separator Co. units can do a better separating job.

**78R Chemical Products.** The Chemical Engineering Catalog gives information on all types of products used in the chemical industry. Published by Reinhold Publishing Corp.

**78L Silicone Defoamers.** Economical, versatile foam killers offered by Dow Corning Corp. Samples available.

**79R Chlorination.** Wallace & Tiernan Inc. chlorinator & proportioning solution panel can correct problems resulting from algae growths in process systems. Bulletin 2136-C.

**81A Plastic Rotary Pump.** Vanton Pump & Equipment Corp. 'flex-i-liner' design eliminates stuffing boxes, shaft seals, gaskets, & check valves. Furnished in polyethylene, Buna-N, & Bakelite for specific applications.

**82R Comparators.** Quick, accurate pH, chlorine tests made with W. A. Taylor and Co. instruments. Free handbook available.

**82L Plastic Pipe Fittings & Valves.** Many years' experience in the manufacture of plastic pumps now applied to 3 lines of plastic pipe, fittings, & valves. Catalog available from Vanton Pump & Equipment Corp.

**83R Heat Transfer Equipment.** Manning & Lewis heat transfer & process equipment is designed to exacting specifications & ensures trouble-free long term operation.

**84BL Flow Test Kit.** For low flow rates of 10 cc/min. to 40,000 cc/min. for gas, & 0.1 cc/min. to 1,400 cc/min. for water, a compact, self-contained kit. Ace Glass Inc.

**85TR Filter Paper.** E-D filter paper used as a medium in filter presses gives exceptional filtrate clarity at low cost. Eaton-Dikeman Co.

**85BR Dryers.** Chemicals dried quickly & economically in steam-heated Dehydro-Mat. Low temperature, variable-inclination, rubber-tired unit dries hard-to-dry chemicals which require hours of hold-up time. Edw. Renneburg & Sons Co.

**86TL Skin Protection.** Kerodex, effective protection against skin irritants, acts like a glove & does not smear. From Ayerst Laboratories.

**86BL Aluminum Grating.** High strength, non-corrosive walkways & handrailing from Washington Aluminum Co., Inc. are designed & custom fabricated to special requirements.

**87R Nickel-Bearing Alloys.** Misco Fabricators, Inc., are specialists in alloy fabrication for use in construction of process units.

**87L Ion-Exchange.** Completely assembled & factory-tested packaged de-ionizers from Illinois Water Treatment Co. are ready to operate as soon as connected. Details & specifications available.

**88TL Pumps.** Nagel horizontal & vertical shaft pumps are particularly designed for abrasive & corrosive applications. Catalog from Nagel Pumps, Inc.

**88BL Nozzles.** A complete line of in-stock nozzles with capacities from ⅛ pt./min. to 4,000 gal./min. in bronze, cast iron, & stainless steel. Spray Engineering Co.

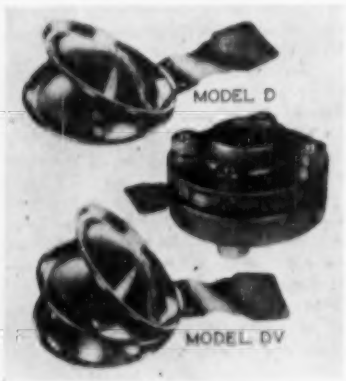
**89L Thrower Units.** Action thrower units will load, trim & pile bulk materials faster, easier & at lower cost per ton. Handle any dry bulk granular or small lump materials to 2 in. sizes. Stephens-Adamson Mfg. Co.

**89R Automatic Speed Control.** Speeds may be changed automatically by use of U. S. Electrical Motors Varidrive motors equipped with Varitrol. Booklet explains operation.

**90L Florite Desiccant.** Said to be the most economical of granular drying agents, Florite has long life, low dew point depression & resists poisoning. Floridin Co.

## DEVELOPMENTS OF THE MONTH *(Continued)*

**87 New Type Rupture Discs.** Black, Sivalls & Bryson, Inc. announces a new type of rupture disc said to extend the advantage of safety head protection to many installations now operating under pressure, temperature & corrosion conditions too severe for conventional type discs.




Model D rupture discs are composed of two matched, prebulged discs which are assembled as a unit for installation. The upper disc is slotted & the lower disc, similar to a conventional disc, provides the pressure seal. Both upper & lower discs determine the rupture pressure & are available in a large selection of materials. This model has no vacuum support & can only be used on systems operating under continuous positive pressure.

Model DV discs are necessary when process systems operate under periodic or continuous vacuum. To prevent collapse or reversal of the sealing disc, a third unit is added to the process side. This unit is called a process support & is spot welded to the other units to make a one-piece assembly.

(Continued on page 45)

**98L Fluid Agitators.** Fluid agitator engineering service backed by 62 years' experience is available from Philadelphia Gear Works, Inc.

**98BR Process Equipment.** Automation equipment for metering, filtering, & blending are available from Bowser, Inc. on lease or other plans. Write for their "Digest."

**99R Steam-Jet Units.** Chemical processes involving high vacuum evaporation, distillation, or vacuum cooling of corrosive materials may indicate use of Croll-Reynolds Co., Inc., Evactor units.

**IBC Tank Heaters.** Thermo-Flo tank heaters are mounted so that the bottom of the tank remains uncluttered, preventing sediment from settling on heating surfaces, avoids efficiency loss. Brown Fintube Co. Bulletin available.

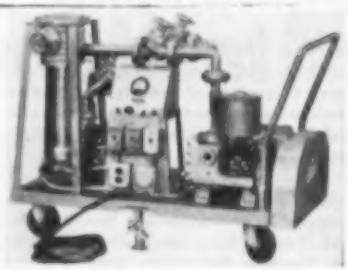
**OBC Lightnin Mixers.** Five ways to get more mixing for your money with turbine-type Lightnin Mixers. Mixing Equipment Co. Bulletins available on latest mixing information.

## DEVELOPMENTS OF THE MONTH *(Continued)*

**58 Portable High-Vacuum Pump.** A new portable high-vacuum pumping station, adapted to pilot plant operations & small scale production applications, is produced by the New York Air Brake Co.

Designed to attain absolute pressures as low as $10^{-6}$ mm. Hg, the new mobile system employs a fractionating 4-inch diffusion pump, connected to a 15 CFM two-stage roughing & backing mechanical vacuum pump. All components including the electrical control panel are compactly mounted on a base fitted with two fixed & two swivel wheels, castor lock & pull handle. Service connections required are a single phase, 60 cycle 110-115 volt A.C. outlet & a source of cooling water.

The unit is recommended for use in exhausting 10 to 15 cu.ft. chambers for vacuum distillation, impregnation, coating, degassing, stress relieving, etc.



The prototype system was designed for use with a mass spectrometer. Duplicate units or modifications to individual customer specifications can be supplied on special order.

(Continued on page 46)

***Technical Literature • Technical Literature • Technical Literature • Technical Literature***

# materials-

**1 Electrochemicals.** Informational product bulletins on sodium and potassium chlorate, ammonium and potassium perchlorate, and manganese dioxide are offered by the American Potash & Chemical Corp. Included are analyses & description of applications to many manufacturing processes.

**2 Hydrogen Peroxide Propellant.** A new bulletin issued by Becco Chemical Division, Food Machinery & Chemical Corp., describes applications of hydrogen peroxide as a propellant. Included are tables and graphs which show physical properties of 90% $H_2O_2$, aparent pH readings for various concentrations, adiabatic decomposition temperatures, specific impulse vs. expansion ratios, & calculated bipropellant performance characteristics for various $H_2O_2$ fuel systems compared with systems using other oxidizers.

**3 Structural Clay Binder.** Ten-page publication describing the use of Polyfon (sodium lignosulfonate) binders for structural clay products is offered by West Virginia Pulp & Paper Co. These binders are said to improve the properties of sewer tile, bricks, porcelain, hollow tile, etc. by imparting easier workability, greater green strength, higher dry strength and higher fired strength.

**4 Asbestocite.** This asbestos-cement sheet material, developed by Johns-Manville, has many industrial applications including cooling tower housings, cold storage room facings, weather protection on insulated outdoor tanks and construction of fume hoods and ducts. Illustrated 6-page folder gives data on physical properties, sizes, thicknesses and dimensional tolerances as well as information on cutting, working & applying.

**5 Sodium Chlorite.** Complete brochure covering properties and uses of sodium chlorite marketed by Olin Mathieson Chemical Corp. under the trade name of Textone.

**6 Polyvinyl Acetate Emulsions.** Paisley Products, Inc., offer custom polymers of vinyl acetate resin in aqueous dispersion in large quantities. Of interest to manufacturers of coatings, paints, sizings, binders and impregnations.

**7 Acetophenone.** Eight-page technical bulletin from Carbide and Carbon Chemicals Company gives information on properties, specifications, constant-boiling mixtures, solubilities, and shipping containers. Also typical reactions and applications to the manufacture of drugs and resins.

**8 Industrial Insulation.** Two bulletins are offered giving descriptive information & technical data on new developments in high-temperature insulation. Eagle-Picher HYLO pipe covering & block has high thermal efficiency and great structural strength. It will resist temperatures up to 1,600° F. Eagle-Picher 85% magnesia pipe covering and block is designed for use in medium or high pressure steam service at temperatures up to 600° F.

**9 Cemented Carbides.** 44-page brochure covers properties and applications of cemented carbides known as Kennametal & Kentanium, both products of Kennametal, Inc.

**10 Low-cost Plasticizer.** Polycon 5B is suitable for use in vinyl formulations where low temperatures and low volatility are desirable. Typical uses are for sheeting, coated fabrics, & film. Additional information available from Brown-Allen Chemicals, Inc.

**11 Universal Foam Adhesive.** Developed by Anchor Adhesives Corporation, No. 292 Polyseam is suitable for foam rubber, polyurethane foam or vinyl foam. Seams are almost invisible and do not harden with age. Foam can also be made to adhere to wood, masonite, steel, aluminum, etc.

**12 Liquid Neoprene.** Wilbur & Williams Co. will supply Neoprene in liquid form suitable for brushing or spraying. Available in black, red, light gray and aluminum colors.

**14 Insulation.** Johns-Manville offers a new bulletin covering all types of insulating & refractory material. Properties and selection charts are given for each item.

**15 Heat Transfer Medium.** Thermon is a non-metallic plastic compound with highly efficient heat transfer properties. It is applied in a viscous paste form over conventional steam-traced or thermal electric systems. Advantages claimed are low cost, excellent heat transfer and long service life. Bulletin from Thermon Manufacturing Co.

**16 New Surface-active Agent.** Sulfonate-type surfactant with unusually high solubility, stability & surface activity in strong electrolyte solutions, developed by Dow Chemical Co. Especially effective in aqueous solutions of acids, alkalies and salts, Dowfax 2A1 is a moderate sudsing agent & is susceptible to foam boosting and defoaming action. Many industrial applications. Technical information and samples sent on request.

**17 Plastic Products.** Complete information on chemical, electrical and mechanical properties of Teflon and "Raylon." (Raylon is reprocessed Teflon). Specifications on sheets, tape, molded and extruded rods & tubes of both materials. Bulletin from Raybestos-Manhatten, Inc.

(Continued on page 46)

# equipment-

**18 Heat Detector Cells.** Servotherm thermister bolometers, manufactured by Servo Corporation of America, are excellent detectors of infrared radiation in the spectral region from 1 to 12 microns or more. Units are designed for use in heat detection, measurement, or control systems where direct contact with the source is inadvisable or impossible. New brochure describes the basic nature and construction of thermister bolometers, static characteristics, dynamic characteristics, noise level, infrared transmitting windows and circuit design considerations.

**19 Dry Processing Equipment.** Bulletin from Sturtevant Mill Co. gives specifications and photos of crushers, grinders, pulverizers, micron-grinders, separators, granulators, blenders, mixers, feeders, screens, conveyors, mechanical dens, and excavators.

**20 Forged Steel Valves.** Bonnetless forged steel valves with outstanding engineering advantages are offered by Velan Engineering Ltd. Catalog includes specifications, flow charts and capacity tables.

**21 Pyrometer Indicators.** Millivoltmeter multiple-point indicators with connector panel or rotary switch are manufactured by the Thermo Electric Co., Inc. Applications to food and chemical processing, pilot plants, power plants and general manufacturing. Descriptive brochure.

**22 Temperature Controllers.** A new series of indicating temperature controllers built around interchangeable elements has been developed by Fenwal, Inc. Interchangeability feature permits user to tailor the control to the application. Every major mechanism, switch type, temperature range, controller element—switching and indicating housing, bulb diameter, capillary length & materials of construction—is available in at least several variations or ratings.

**23 Sight Glasses.** Sight glasses which require neither solder nor gaskets, thus eliminating the main sight glass failure points, are made by Corning Glass Works. Glass is hermetically sealed to metal. Result: windows which are tamper-proof, unaffected by aging or vibration, & resistant to high pressures. Details on request.

**24 Hermetic Centrifugal Refrigerating Machine.** New Carrier design features push-button operation and low installation costs. Engineering data to assist architects & consultants has been assembled in an illustrated catalog offered by the Carrier Corp.

**25 Forged Steel Products.** Catawissa Valve and Fittings Co. has released a new catalog containing engineering data, specifications and prices on their complete line of hot forged steel products. Described in detail are many types of pipe unions and swing check valves. Catalog.

**26 Centrifugal Pumps.** Construction features, performance data and specifications of a line of "close-cupid" centrifugal pumps is described in a new bulletin offered by Goulds Pumps, Inc.

**27 Air Control Valves.** Hanna Engineering Works announces development of a series of solenoid and master air valves. These valves are especially adapted to controlling air cylinders and other air-operated devices. Outstanding for dependable performance, safe operation & easy maintenance.

**28 Chlorine Vaporizer.** The Whitlock Standard Chlorine Vaporizer is recommended wherever process conditions require relatively large quantities of chlorine in dry gaseous form. Features are high capacity, simple design and heavy construction, simple control, and easy disassembly. Small chlorine content assures safe operation and rapid volatilizing puts vaporizer on the line without delay. Details on request. Whitlock Manufacturing Co.

✓ **CHECK** *your Data Service requests on the handy postcard on page 41 to*

▶ **GET** *up-to-the-minute catalogs, data sheets and bulletins on new chemical products, processes and equipment.*

**29 Solenoid Valves.** 33-page catalog of Automatic Switch Co. includes valve selection chart, flow charts, nomographs, and detailed specifications of various types of solenoid valves.

**30 Alloy Tubing.** Bishop & Co. Platinum Works has re-issued its 12-page catalog on cold drawn mechanical, capillary, hypodermic, nickel, and nickel alloy tubing. Data is included on comparative analysis of alloy types, specifications, standard tolerances, physical properties, and relative workability.

**31 Shipping Containers.** Columbiana Boiler Co. produces special one-ton shipping containers for liquefied and compressed gases and chemicals such as liquid chlorine, anhydrous ammonia, sulfur dioxide. 24-page booklet contains tables and charts giving characteristics of liquid chlorine.

**32 Flow Rate Regulators.** Direct-acting liquid flow regulators, manufactured by W. A. Kates Co., are designed to measure flow rates within the unit, then convert the finding directly into a corrected port opening. Available in both gravity- & spring-actuated models. Technical bulletin.

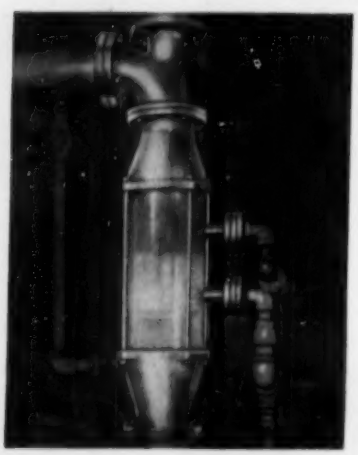
**33 Pipe Joint Tape.** L.O.F. Glass Fibers Co. introduces a new coated tape for field wrapping of joints & fittings on underground pipe lines. Duratape, a glass fiber mat coated on both surfaces, is now available with asphalt as well as coal tar coatings.

**34 Millivoltmeter Microammeter Recorder.** A highly accurate strip (or card) recorder for low-level direct current electrical measurements. Combines economy and simplicity of direct-deflection movement with powerful, solenoid-operated pen drive system. For voltage ranges from 0-20 millivolts up to 0-100 volts d.c.-current ranges from 0-200 microamperes to 0-100 milliamperes d.c.—input sensitivity of 6,700 ohms per volt. Complete descriptive bulletin from manufacturer, Manning, Maxwell & Moore, Inc.

**35 Thermocouple Vacuum Gauge.** Simple to operate, compact in construction. Range from 0.5 microns to 1,000 microns Hg. Temperature-compensated with accuracy of

(Continued on page 50)

## DEVELOPMENTS OF THE MONTH *(Continued)*



**39 Continuous Pipeline Mixer.** The American Well Works has published an addendum to their Technical Supplement HM on the use of the Homomix in continuous chemical mixing without a mixing tank. The general theory of mixing is discussed as well as viscosity & fluid classes, continuous mixing vs. batch mixing, & the advantages of continuous mixing.

Operation of the Homomix as a continuous & as a batch mixer are explained, with curves on size & capacity. Also treated are materials of construction & linings, typical liquid & gas flows, lift stages, design modifications. Illustrated is the 2-in. (50 PM) Homomix continuous pipeline mixer. Available in sizes up to 15,000 gal./min.

(Continued on page 50)

# High Speed Reduction to Micron Sizes — No Attritional Heat!


**ENGINEERING FLUID-JET GRINDING IN "PACKAGE UNITS"**

. . .. comes naturally to Sturtevant engineers — with their 75-year tradition of successful solving of dry-processing problems. If you want to accomplish the most effective grouping of a Micronizer* Grinding Machine with necessary compressor, feeder and dust-collector, it will pay you to investigate. Check the coupon on the right for more information.

## Sturtevant Micronizer* Grinding Machines Give Greater Finenesses than Tube or Roller Mills

**Look at the record!** 30 inch model reduced titanium dioxide to 1 micron and finer at solid feed rate of 2250 lbs. per hr. 24 inch model reduced DDT (50%) to 3.5 average microns — 1200-1400 lbs. per hr. 8 inch model reduced Procaine—Penicillin—to 5 to 20 microns—up to 20 lbs. per hr. Couldn't you use milling performances like these?

**No moving parts.** The particles grind each other. High-speed rotation and violent grinding impact of particles are caused by jets of compressed air or steam at angles to the periphery of the shallow grinding chamber. There are no problems of attritional heat. Centrifugal force keeps over-sized particles in the grinding zone. Cyclone action in the central section classifies and collects the fines for bagging.

**Instant accessibility, easy cleaning.** Micronizer* Grinding Machines come in seven sizes — each one constructed for quick accessibility and easy maintenance (typified by the "OPEN DOOR" design in other Sturtevant equipment). Grinding chambers range from the 2 in. laboratory size with ½ lb. per hr. capacity to the 30 in. size which handles up to 3000 lbs. per hr.

* Registered trademark of Sturtevant Mill Co.

# STURTEVANT

## *Dry Processing Equipment*

**The "OPEN DOOR" to *lower* operating costs over *more* years**

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

My dry-process materials are:_____

Desired capacity is:_____

Name_____ Title_____

Firm_____

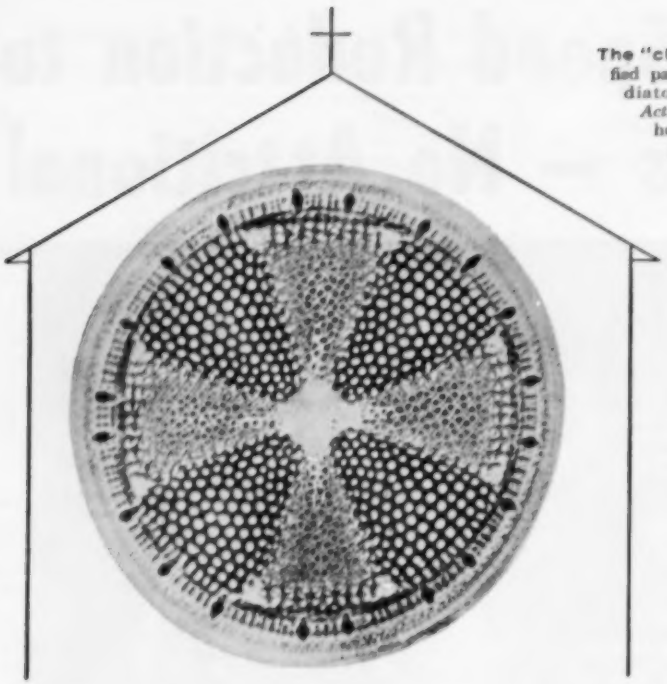
Street_____

City_____ Zone_____ State_____

**STURTEVANT MILL COMPANY** 135 Clayton Street, Boston 22, Mass.

**Please send me your Micronizer* Bulletin** ☐
**Also bulletins on machines for:**

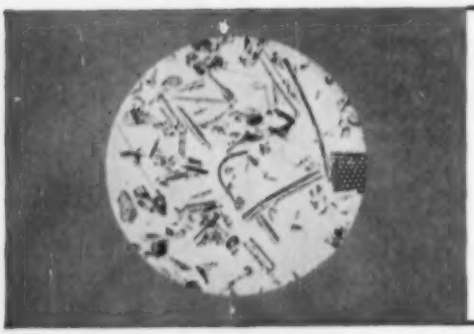
☐ CRUSHING ☐ GRINDING ☐ PULVERIZING
☐ SEPARATING ☐ BLENDING ☐ MIXING
☐ SUPERFINE SELECTING ☐ GRANULATING ☐ CONVEYING



**The "church window"** is a magnified particle (app. 600X) of Celite diatomaceous earth known as *Actinoptychus*. It is just one of hundreds of different intricate particles that together make J-M Celite such an effective filter aid.

*What's this "Church Window" got to do with more uniform filtrations?*

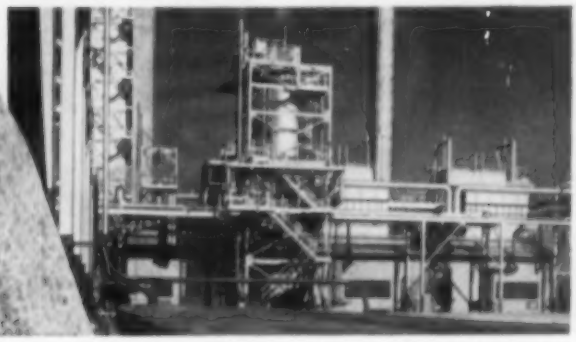
# It's a particle of CELITE that's always uniform



**The secret** of Celite diatomite's remarkable filtration properties is shown in this magnification. It reveals the open passages between particles, and the porosity of the particles themselves through which liquids flow freely. Yet these openings are so microscopic that they trap even the finest insoluble impurities.

**Johns-Manville CELITE**

**Filters impurities from monosodium glutamate.** Celite filtration meets the high purity standards of the food industry in removing microscopic, non-crystallizable impurities from the widely used food product—monosodium glutamate.



**Provides sparkling clear drinking water.** Many municipalities depend on Celite filtration to help keep drinking water uniformly healthful and pure. Celite efficiently removes amoebae and algae . . . reduces the need for other chemical treatment.

**Removes oil from urea solutions.** Hyflo and Sorbo-Cel, two special grades of Celite, are used by the chemical industry to filter oil from urea solutions used to make plastic grade resins.

# -the diatomite filter aid from bag to bag

BUY a bag of Celite* in New York today. Next year, buy another bag of the same grade in California. You can depend on getting the same performance from both bags because Celite is always uniform.

Every pound of Celite comes from the world's largest and purest commercially available diatomite deposit. Every pound is processed and graded at the same plant under the same conditions. Yet, with the large inventory maintained at the plant and Johns-Manville's nationwide network of warehouses, you're assured of fast, sure delivery when and where you want it.

Celite gives you more economical filtration, too. Because of its lower wet density, you get greater surface coverage—actually 6 bags of Celite will do the work of 7 bags of other diatomites. Celite filter powders come in a full range of grades. It's easy to select the one grade that gives you the clarity you need at the fastest flow rate.

So, if filtration belongs in your processing operations, it will pay you to call in your local J-M Celite engineer. Backed by Johns-Manville's research facilities and years of practical diatomite experience, he can help you with your filtration problems. Call him today or write Johns-Manville, Box 14, New York 16, New York. In Canada, write 565 Lakeshore Road East, Port Credit, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

**Diatomite Filter Aids**

JM PRODUCTS

## equipment-

(Continued from page 46)

within 2%. Details, including illustrated specification sheet, available from manufacturer, Arthur F. Smith Co.

**36 Remote Control System.** Tubeless electronic circuit gives positive remote control with polarized pulses. Saves cost in remote control of mechanically, electrically, pneumatically or hydraulically operated machines & devices. Requires only two wires or single wire & ground return. Technical brochure from Sparks-Withington Co.

**37 Processing Equipment.** Star Tank & Filter Corp. offers filter presses, flush bottom valves, commercial and pilot plant scale processing vessels, including autoclaves and reactors. Data sheets and price schedules.

**38 Miniature Bayonet Thermocouples.** Thermo Electric Co. announces advances in the design of miniature bayonet thermocouples including wider variety of immersion lengths, adapters, lead wires, and terminals. Specially suited for temperature measurement of engine and pump-cylinder heads, turbine housings, pipes, electric motors, generators, transformers, plastic extruders and molding machines.

**39 High Capacity Flowmeters.** Specially designed for high capacity services which demand linear flow output, wide range, & freedom from piping limitations. Maximum flow rates of 60 to more than 4,000 gpm handled in meters with 2 to 12 inch connections. Circle number 39 for complete Fischer & Porter catalog.

**40 Aero Vapor Condenser.** Niagara Blower Company bulletin describes new apparatus for condensing vapors independent of a large supply of cooling water. Illustrations include units cooling reflux liquids and condensing vapors at top of distillation towers.

**41 Chlorine-Caustic Soda Handling.** Illustrated wall charts with up-to-date instructions for safe handling of chlorine and caustic soda will be sent to users & handlers by Olin Mathieson Chemical Corp. Charts are of weatherproof, plastic-impregnated paper suitable for indoor or outdoor hanging. Included are instructions for unloading and preparation of tank cars as well as safety and first aid measures.

**42 Valve Stem Packings.** Descriptive bulletin by Raybestos-Manhattan, Inc. lists shapes and size limitations. Gives recommendation chart for standard items when used against various fluids and gases.

**43 Thermal Shock Resistance.** Important data and information on the thermal shock resistance of refractories are contained in a brochure published by the Carborundum Co.

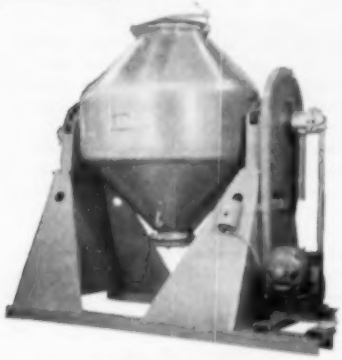
**44 Pneumatic Operators.** Pneumatic spring and diaphragm operators are illustrated &

(Continued on page 52)

## When you dry or blend materials take advantage of these Pfaudler services

To any company which dries or blends materials, Pfaudler offers testing facilities with their glassed steel dryer-blender to help you evaluate their performance for your product.

A test unit is maintained in our laboratory at all times for conducting sample runs. Free of charge, your product will be processed and a full report made to you or you can send your own man to observe performance.



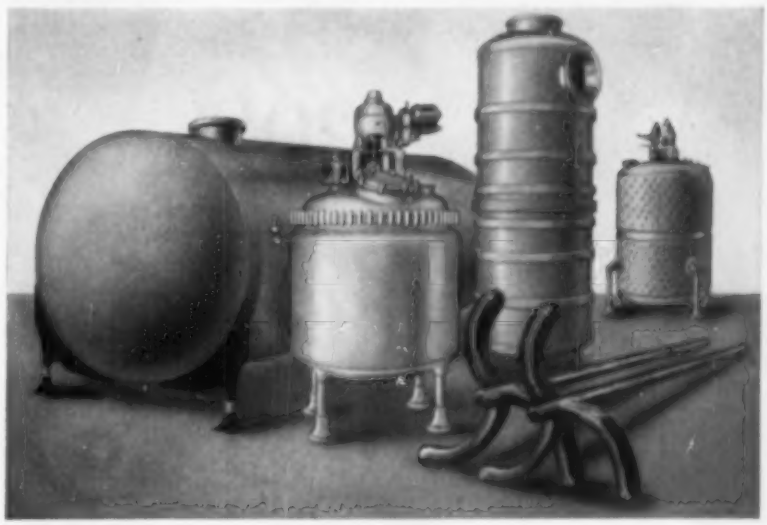
Conical dryer-blender of glassed steel construction provides high corrosion resistance with efficient heat transfer. Unit like this is available for test purposes.

A portable unit is also available for setup in your own plant for which a nominal charge is made. In either case, you can determine the effectiveness of these corrosion-resistant units for your products.

In actual operation, these Pfaudler units, by combining rotational tumbling action, vacuum and heat, have stepped up drying cycles from days to a matter of a few hours. Full-scale machines are available in 4, 32, 107 and 255 cubic-foot capacities. Data Sheet 26 gives you the details. Send for it.

### 1956 BUYER'S GUIDE READY

A new, more comprehensive guide to Pfaudler engineering services and the various types of corrosion-resistant process equipment offered by Pfaudler in various types of construction materials is now available. It describes how you can supplement your engineering staff in arriving at new ways to process or in obtaining better performance from existing process equipment. A copy is yours for the asking.



From storage tanks to reaction equipment, Pfaudler glassed steel offers far more corrosion resistance than most materials of construction, and usually at a much lower cost.

## YEAR'S GUARANTEE ON CORROSION RESISTANCE OF GLASSED STEEL

### *Unique in process industry*

A unique measure of the improvement that has been made in both the corrosion resistance of Pfaudler glass and its bonding to steel is the fact that it is the *only material of construction which carries with it a full year's guarantee against corrosion.* If chemical attack should render your Pfaudler glassed steel equipment unuseable within its first year of use under the operating conditions specified in the guarantee, Pfaudler will repair or replace it without charge by on-the-spot methods or on an F.O.B. factory basis.

Pfaudler glass is now resistant to *both* acids (except hydrofluoric) and alkaline solutions up to pH 12 at 212° F. This makes it suitable for a remarkable range of corrosive services—more than almost any other known material.

It is standard on glassed steel equipment for reactions, fractionation, absorption, stripping, extraction, solvent recovery, etc. Much of this equipment is standard in design, which also reduces initial cost and delivery time.

If you are not up-dated on the many real advantages that go with modern Pfaudler glassed steel equipment, let us send you the 1956 Buyer's Guide.

### How much do you pay for heat exchangers?

If you still order specially designed heat exchangers for each job, you are probably paying more than necessary.

Pfaudler stockpiles a line of flexible standard heat exchangers. They give you the economy of standardization and a flexibility which make them adaptable to wide usage.

The fixed tube sheet exchangers are available in stainless steel and other alloys. *Economical*—lowest first cost of any type of heat exchanger. *Versatile*—they can be used as heater, cooler or condenser. *Easy to clean*—tubes are straight, heads are removable. *Leakproof*—no internal gasket. No possible intermixture between hot and cold side fluid through gasket failures. *Fast delivery*—shipment of type 316 stainless steel tube side units in 10 days.

For all the facts, ask for "Manual 837."

# equipment-

(Continued from page 50)

described in a new bulletin available from the Conoflow Corp. Emphasis is on typical combinations with butterfly valves, adjustable port valves, burner valves, etc.

**45 Vibratory Equipment.** Eriez Manufacturing Co. offers 6-page, 2-color folder describing new type of electro-permanent magnetic vibratory equipment. Vibratory feeders and unit feeders are based on design which incorporates a lifetime permanent Alnico magnet and an AC electromagnet. No separate rectifier is needed.

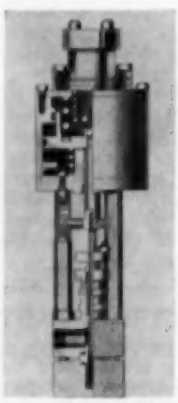
**46 Rotary Blowers.** Light weight, compact rotary positive blowers are built for all production and process services by Miehle-Dexter. Discharge pressures to 14 psig, vacuum to 15" Hg, capacity 50 to 4,000 CFM. Bulletin.

**47 Process Equipment.** A new brochure published by Dravo Corp. gives design & construction details for intensive mixers, liquid blenders, dissolvers, kneading machines, pressure filters, ball mills, conical blenders, horizontal blenders, quick-opening doors, pressure vessels, & other types of process equipment. Copies may be obtained by circling number 47.

**48 Steam Pressure Reducing Valves.** Complete line of spring-loaded, piston-operated and internal pilot actuated steam pressure reducing valves is described in

(Continued on page 54)

## Developments of the Month *(Continued)*



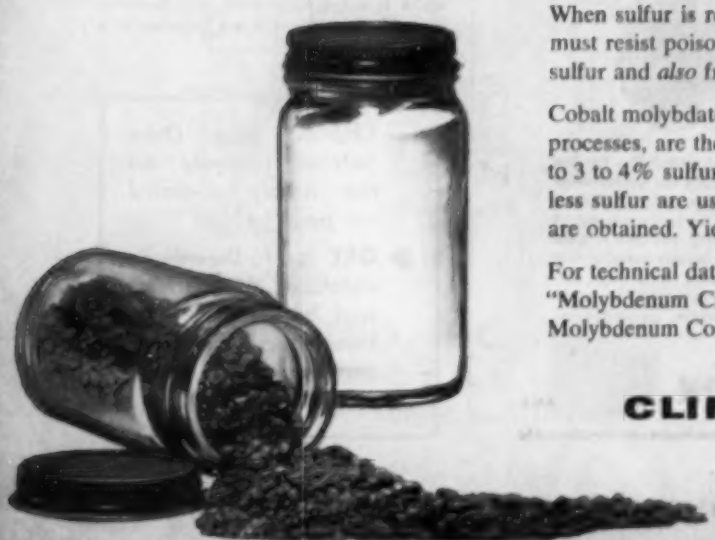
**60 Small Flow Control Valve.** The Annin Co. has announced production of a new series of valves designed for working pressures up to 6,000 psi. Model 9460 is expected to provide industry, research laboratories & pilot plants with an extremely high-speed & very responsive small flow valve.

Interesting development is use of a differential area piston which eliminates need for loading regulator & will stroke fully in either direction in 0.75 seconds or less.

Offset globe or angle bodies are featured with body sections rotatable in 90 degree increments for piping convenience.




# Moly catalysts resist poisoning



When sulfur is removed from petroleum stocks, the catalyst must resist poisoning. It must withstand contamination from sulfur and *also* from nitrogen and metallic contaminants.

Cobalt molybdate catalysts, in a number of different commercial processes, are the answer to these difficult specifications. Stocks up to 3 to 4% sulfur by weight have been processed. When stocks with less sulfur are used, products containing as little as 0.1% sulfur are obtained. Yields are almost 100% of theoretical.

For technical data about molybdenum catalysts write for our bulletin "Molybdenum Catalysts for Industrial Processes." Dept. 23, Climax Molybdenum Company, 500 Fifth Avenue, New York 36, N. Y.

**CLIMAX MOLYBDENUM**

## Technical Literature •

## equipment-

(Continued from page 52)

detail in six-page handbook offered by Atlas Valve Co. Feature of booklet is capacity chart for valves ranging from ½" to 8" and initial pressures from 30 to 1,500 psi. Copies on request.

**49 Infrared Spectrophotometry.** Special article on infrared spectrophotometry in the pharmaceutical industry highlights latest edition of the Beckman Infrared Notes put out by Beckman Instruments, Inc. Particular emphasis on present use in pharmaceutical research and control. Selected bibliography of infrared applications in this field.

**50 Gas Regulators.** Rockwell Manufacturing Co. has revised its 12-page bulletin describing complete line of gas regulators. Included are maximum capacity tables for all models and cuts showing sectional views & construction details.

**51 Syncrogear Motors.** U. S. Electrical Motors produces a complete line of various types of syncrogear motors. Illustrated bulletin lists ratings from 1.3 to 30 hp with gear ratios up to 10:1. Application of elliptoidal helical gears is discussed. Of special interest is chart graphing degrees of tempering & hardening of gear teeth.

**52 Flow Meters.** Pilot plant operators will be interested in a line of flowmeters made by the Matheson Co. Calibrations may be calculated from properties of the flowing gas. Flowmeter tubes are specially mounted to give ease in interchangeability and end fittings are designed in a choice of metals & outlet types to allow connection into any system. Bulletin available containing many useful pressure & temperature correction charts & calibration curves.

**53 Metering Pumps.** Hills-McCanna specialize in pumps for all types of water treatment systems. Their "U" type pump is a mechanical drive unit for precisely controlled metering and proportioning of small volume flows. Larger capacities are handled accurately with the "K" type pump, which is a hydraulic drive unit. Specifications & selection charts are included in a bulletin.

✓ **CHECK** *your Data Service requests on the handy postcard on page 41 to*

▶ **GET** *up-to-the-minute catalogs, data sheets and bulletins on new chemical products, processes and equipment.*

# WHO'S WHO AT THE PITTSBURGH MEETING

**Here are the speakers, panelists, and authors you will be meeting at Pittsburgh September 9-12. Here too, are some last minute highlights of a meeting that promises to be outstanding both in extent and quality.**

## AUTHORS AND SPEAKERS

Sept. 9


Denig


Raynolds


Hill


Schoenborn


Hedrick


Wangeman


Webb

Sept. 10


Mayor Lawrence


Creelman


Ackoff


Wallen


Ware


Sege


Isbin


McNutt


Arnold


Bowman


Hashbarger


Shorkey


Marshall


Klingel


Schrac-


Foust


Schnaible


Leva


Faith


Churchill


Ludt

Sept. 11


Genereaux


Arnold


Groot


Cooper


Jealous

It has just been announced that Clifford C. Furnas, Assistant Secretary of Defense for Research and Development, and a famed chemical engineer and educator, will be the Banquet speaker on Tuesday night, September 11. His subject on "some engineering aspects of national defense," is vital to all of us. The significance of Furnas' presence before an audience of chemical engineers, as a representative of defense, is the importance of the subject of defense technology these days to all men engaged in technological activity. A graduate of Purdue, former associate professor of chemical engineering at Yale, research chemist with U. S. Steel, physical chemist at the U. S. Bureau of Mines, director of research for Curtis-Wright Airplane Division, and executive vice president and director of Cornell Aeronautical Laboratory, Furnas has the background to discuss the role of modern technological developments in national defense.

At the Monday luncheon meeting, Mayor D. L. Lawrence of Pittsburgh will greet the engineers in a formal welcoming address that will certainly do much to unfold the importance of engineering and industry in the life of this great industrial city.

Tuesday's luncheon will feature Ray P. Genereaux as speaker. Immediate past chairman of the Institute's Nuclear Engineering Division, Genereaux is widely known in both the chemical and nuclear engineering fields, partly for his outstanding contributions to the design and construction of AEC's Hanford and Savannah River plants.

### High Attendance

Interest in the technical program at Pittsburgh has been extremely high, with five symposia vying for the engineer's time.

So high, in fact, has the interest been that the Meeting Arrangments Committee now expects that Pittsburgh may have the highest number of engineers in attendance at any national meeting to date. Don't worry, there is plenty of room for all, but of course the old rule of 'first reserved first served' will apply.

### New Engineering Site

The meeting will also be the occasion of a two-day session of Council. Among the subjects to be discussed will be the proposed new Engineering Center in New York, and what the A.I.Ch.E. is going to do about participation in the venture. (See page 92 of the July issue of *CEP.*) This is an extremely important subject for the future of the Institute and the engineering profession, and much careful analysis and discussion must be devoted to it. The results of

## REMINDER

**SHIPPINGPORT NUCLEAR REACTOR**

Members are reminded that this important plant trip on Monday, September 10, is limited to 80 participants. Pre-registration is urged for all interested engineers.

this Council meeting will be vital to all chemical engineers.

**Committee Meetings**

Below there is a list of the committees which will meet at Pittsburgh. J. C. Lawrence, Sr., chairman of the Standards Committee, expects the subcommittees on Standards for Tubular Heat Exchangers, and Standard Specifications for Bubble Cap Columns, to make interim reports. The meeting of the equipment Testing Procedures subcommittee on Mixers is understood to be readying for discussion a draft of its developing Procedures.

**Not All Work**

The lighter side of life will not be neglected at Pittsburgh. Starting with Sunday night's "Get Acquainted Party," where free refreshments will be served to members in the ballroom of the Penn-Sheraton (new name of the headquarters hotel), and moving on through the many informal mixers and other gatherings, to the final banquet for attendees and wives, there should be ample opportunity to make a host of new friends at Pittsburgh.

## NATIONAL COMMITTEE MEETINGS

*Monday, September 10*

9:30 AM-5:00 PM: Equipment Testing Procedures Mixers Subcommittee.*
10:00 AM: Research.
10:00 AM-2:00 PM: Standards.*
4:00 PM: Equipment Testing Procedures Subcommittee Chairmen.
2:00 P.M.: Membership.
4:00 PM: Pollution Control Engineering. (A representative of the U. S. Public Health Service will discuss significant changes in the Federal Pollution Control Law.)
4:00 PM: Sections Activities.

*Tuesday, September 11*

9:00 AM: Chemical Engineering Education Projects.
2:00 PM: Career Guidance.
2:00 PM: Research.
2:00 PM: Public Relations.
4:00 PM: Equipment Testing Procedures Distillation Subcommittee.

** Luncheon will be served.*

**Photographed at the April 30 meeting of the General Committee for the Pittsburgh National Meeting Sept. 9-12 were, right to left, front row: Carl Monrad, chairman, Tech. Prog.; Mrs. H. B. Coats, co-chairman, Ladies' Prog.; H. B. Coats, general chairman; Mrs. O. A. Webb, co-chairman, Ladies' Prog.; O. A. Webb, vice-chairman, Prog.; & Warren Trigg, vice-chairman, Plant Trips. Second row: J. Joseph, chairman, Hotel & Hospitality; R. Capell, vice-chairman, Regist.; C. Holloway, chairman, Regist.; J. Bradshaw, Secy. & Treas.; J. Obey, vice-chairman, Entertain.; C. F. Houck, chairman, Pub. Rel.; & T. Liggett, vice-chairman, Hotel & Hospitality. Back row: R. Rhodes, chairman, Entertain.; C. A. Bishop, chairman, Printing; W. King, vice-chairman, Facilities; F. Van Antwerpen, A.I.Ch.E. National Secy.; M. M. Ramer, vice-chairman, Pub. Rel.; R. R. Rothfus, chairman, Facilities; & E. O. Ohsol, chairman, Plant Trips.**

Hancher | E. R. Johnson | Reinhart | Damon | Hartmann | Lewis

Burgoyne | Stewart | Zabetakis | Amundson | Latimer | McHenry


Comings | Edmister | Toor | Sept. 12 | Edmister | Rose

Beutler | Bonner | Rushton | Oldshue | Rodger | Lindahl

Nolting | Humphrey | Friedlander | Greathead | Gray | Weindenbaum

INDUSTRIAL NEWS

## NEW MAGNESIUM PLANT WILL ADD 15% to U. S. PRODUCTION

**Plans for 1957 operation announced by Alabama Metallurgical Corp., jointly owned by Brooks and Perkins and Dominion Magnesuim, Ltd., of Toronto.**

A new $7 million plant, capacity 10,000 tons annually, will use the ferrosilicon reduction process of Dominion Magnesium. Product's high purity is expected to be an important factor in the reduction of uranium, titanium and zirconium in addition to its uses in the structural field.

Plant location in Selma, Ala., was chosen because of "optimum conditions for availability of dolomites, quartzite, fuels, electric power and labor."

---

**The production of formaldehyde, methanol, acetaldehyde, and certain other organic chemicals will be increased by 25%** at Celanese's plant in Bishop, Tex. The major expansion is expected to go on stream early in 1957. New facilities will make the Bishop plant the world's largest producer of formaldehyde. □

**An improved electrolytic cell, developed by Pennsylvania Salt Manufacturing Co.'s technical personnel,** will replace sodium chlorate cells at the company's Portland, Oregon, plant. New facilities are expected to be ready by early next year. □

In the picture—an electronic industrial tractor that requires no operator. Manufactured by Barrett-Cravens Co., Northbrook, Ill., the tractor operates by means of a guide wire under the surface of the floor, taped to the floor, or overhead, which emits an electronic signal picked up by a guidance receiver on the tractor. The tractor is also equipped with manual controls if it is desired to use it as a conventional tractor.

## INDUSTRIAL NEWS

**Exclusive rights to the Karl Fischer formaldehyde process have been granted to the Borden Co.'s Chemical Division.** Under the terms of the contract with the West German engineering firm, Borden may also license other producers. The new system will provide an increased yield, and will lower utility and steam requirements for processing. A 93% yield is anticipated, compared with a national average of 82-88%. The new agreement will add considerable momentum to Borden's fast-moving expansion in the field. □

**Production of man-made rubber in the formerly Government-owned plant at Institute, W. Va., got underway recently as this 75-lb. bale came from the production line. This is the first production at Institute since 1953. Goodrich-Gulf Chemicals bought the plant for $11 million.**

**Sulphur will be manufactured from hydrogen sulphide extracted from the natural gas of the Peace River area of Alberta and British Columbia** in a plant to be built under the terms of a new contract between Jefferson Lake Sulphur Co., New Orleans, La., and Pacific Petroleums, Ltd., Calgary, Alberta. Pacific Petroleums is now constructing an $18 million gas processing plant which will remove the hydrogen sulphide and liquid hydrocarbons from the gas.

Sulphur plant will cost $1,800,000, initial production will be about 300 long tons a day, within five years the plant should produce between 500 and 600 long tons a day. □

**A 45% increase in annual production of carbon and graphite electrodes, anodes, mold stock and graphite specialties** is in the works for the Electrode Division of Great Lakes Carbon Corp. The new facilities will be added at the Division's plants in Morgantown, N. C., and Niagara Falls, N. Y., are expected to go on-stream in May of 1957. □

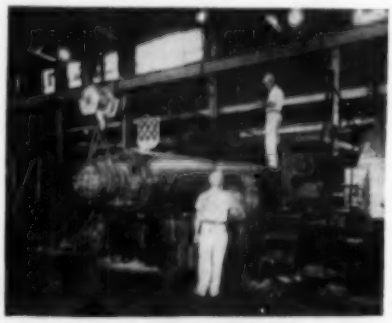
## INDUSTRIAL NEWS

**A license to manufacture an expandable polystyrene, and to mold the expanded material into finished articles,** has been acquired by the United Cork Companies of Kearny, N. J. The license permits the company to utilize the processes and techniques developed by Badische Anilin & Soda-Fabrik A. G. of Ludwigshafen, Rhine, West Germany, already commercially used throughout Europe. The new product will be marketed under the trade name "Uni-Crest." □

**The last of the 28 Government owned rubber producing facilities, the alcohol-butadiene plant at Louisville, Ky.,** has been sold to Union Carbide for $3,125,000. Currently under lease to Publicker Industries, Inc., the plant will not be operated by Carbide until the lease terminates in April, 1958. The sale is also subject to clearance by the Attorney General on antitrust matters, and to review by Congress. □

**First product to go on-stream at Reilly Tar & Chemical Corp.'s new production facilities at its Indianapolis plant, is 2,6-Diaminopyridine,** a chemical growing rapidly in importance as a curing agent for epoxy resins. □

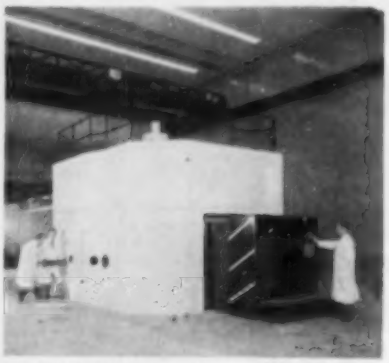
**A $38 million high energy fuel plant will be built by Callery Chemical Co.,** a wholly owned subsidiary of Mine Safety Appliance Co., under a cost without fee contract from the Department of the Navy. The plant will be located on Government owned land near Muskogee, Okla., is already in the design stage. □



**This suction press roll, 240 inches long and 36 inches in diameter, is fabricated of Monel, the largest roll ever fabricated from the nickel-copper alloy. Installed on a Fourdrinier machine at Union Bag & Paper's Savannah, Ga., plant, the perforated roll is expected to virtually eliminate the periodic shutdowns for reaming and surface refinishing through its superior corrosion-resistance and wetability.**

**Fabricated from three two-inch Monel plates weighing a total of 12,500 pounds, cold pressed into 120° sections by Babcock & Wilcox, welded longitudinally by Youngstown Welding and Engineering, the roll was drilled with thousands of holes to complete the job.**

## NUCLEAR NEWS



World's first private nuclear reactor for industrial research is at the Armour Research Foundation of Illinois Tech, Chicago, was designed and built by Atomics International, a Division of North American Aviation.

**AEC is sponsoring a conference on engineering education and nuclear energy** for college and university presidents and deans of engineering at Gatlinburg, Tennessee, Sept. 5-8. Representatives of 150 institutions having accredited engineering courses have been invited. The conference, suggested by the ASEE, will provide an opportunity for college and university administrators to discuss programs of education and training for students planning nuclear energy careers. Planned are presentations and discussions of recent developments in engineering education in nuclear energy, of anticipated needs for trained personnel, and of the Commission's educational and training program in the field. □

**Sixty engineering professors from 36 American engineering colleges and universities are now attending a two-month nuclear engineering course at Argonne National Laboratory.** Purpose of the course is to provide engineering college faculty members with the training which will help them to incorporate nuclear engineering material into their courses of instruction. □

**Boral, a neutron shielding material, is now commercially available in plate and sheet sizes 48 in. by 120 in., and 36 in. by 96 in.,** the largest sizes ever produced in this material. Made by Alcoa, boral is fabricated from boron carbide and aluminum, is ideal as a component for shields to control speeding neutrons in nuclear reactors. □

**An Institute on Nuclear Science and Engineering is being held at Brookhaven National Laboratory this summer,** with 30 engineering professors from 22 different institutions in attendance. □

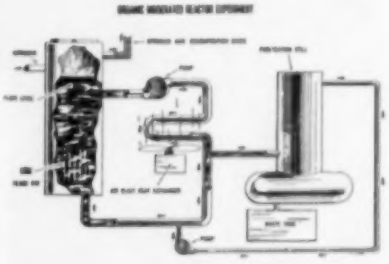
**A ten-million-volt "atom smasher," known as the Tandem Accelerator, will be developed and constructed by High Voltage Engineering Corp., Cambridge, Mass., for the Chalk River project of Atomic Energy of Canada, Ltd.** Expected to be installed early in 1958, the machine will enable Chalk River scientists to study in continuous detail the nuclear energy level of heavy elements, known only in patches today. □

**A contract for critical assembly studies of a small heterogeneous boiling water reactor for military application** has been awarded to Battelle Institute by AEC. A one year study is called for and the objective of the study is to determine the range of usefulness of a control system in which the reflector, rather than control rods, is used to control the reactor. □

**A joint proposal for the construction and operation of a privately owned plant for the refinement of uranium compounds** has been submitted to the AEC by Climax Molybdenum Co. and Mallinckrodt Chemical Works.

If the proposal is accepted, a jointly owned company will be formed with Climax as the majority owner. □

**Six specially designed mass spectrometers have been ordered by AEC from the Beckman Instruments, Inc.** This is the second such order (100 were delivered last year) of these instruments used to guard the purity of fissionable material. The six new instruments will go to AEC's Portsmouth, Ohio, project.



A new type of experimental atomic energy reactor to help develop lower costs of electricity from nuclear energy for small capacity plants is being designed and built by Atomics International, a division of North American Aviation, under contract with AEC. In the drawing, heat from the atomic fission process in the reactor core (left) is absorbed by an organic material, such as the carbon-hydrogen compound diphenyl. The hot liquid gives up its heat through heat exchangers (center). Electric power could be produced by using conventional steam boilers and generators to convert heat to electricity. At right is the diphenyl purification still. About 16,000 kw in the form of heat will be produced.

MORE AND MORE MANUFACTURERS REPORT:

# Photosensitization processing with Hanovia photochemical equipment increases output, effects substantial production savings

**Hanovia Utility Model Quartz Lamp.** Provides high intensity concentrated source of ultraviolet radiations. This compact, powerful laboratory-size ultraviolet lamp is of major value for preliminary determination of the potential benefits of photochemical reactions in your own processes. The Hanovia Utility Model Quartz Lamp has proven excellent, too, for use in all phases of ultraviolet photography, i.e. "reflected ultraviolet procedure" and the "fluorescence method". It is highly satisfactory for illumination of optical apertures, for microscopy and absorption spectra studies.

**Hanovia Laboratory Photochemical Reaction Equipment.** Excellent for testing actinic radiation processes to evolve and evaluate commercial actinically sensitized reaction techniques. Hanovia double-walled quartz or Vycor immersion wells fit standard 5 or 12 liter laboratory flasks. Permits maximum light utilization of mercury-vapor ultraviolet lamp, studies of admixture of reactants and temperature control.

**If your production** involves synthesis, decomposition, hydrolysis, hydrogenation, oxidation, reduction, polymerization, bleaching, precipitation, isomeric change, and halogenation, surely it is in your interests to investigate Hanovia Photochemical Equipment. It may prove to effect as substantial savings for you as it has for a rapidly increasing number of manufacturers — large and small.

Hanovia Photochemical Equipment produces greater output in less time with less plant equipment, and with substantial savings. Hanovia Photochemical Equipment has proven the powerful and suitable source for actinically sensitized reactions.

**YOURS ON REQUEST:** Valuable, informative 16-page brochure, PHOTOSENSITIZATION, a review, details facts on Photochlorination, Oxidation, Hydrolysis and Hydrogenation, Polymerization, Bromination, Isomeric Transformation, Decomposition, etc. Each subject is fully described in light of proven techniques and results, with complete bibliography included. Write today for your copy without obligation.
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## ENGINEERING MANPOWER SHORTAGE—WHERE DO ENGINEERS WORK?

**Carnegie Tech survey discloses that a majority of its science and engineering alumni are functioning in the higher echelons of administration and management.**

Much attention has been given of late to that aspect of the technical manpower shortage resulting from the apparent reluctance of high school students to enter the fields of science and technology.

Now a survey made at Carnegie Tech sheds some light on the other end of the engineer-producing stream—the utilization of technical people after graduation. Result: The majority of technically trained men graduating in the past from Carnegie are not working in technology.

In the survey that involved some 18,000 alumni, of whom 95% furnished the required information, roughly 11,500 are holders of degrees in engineering or science, but only 2,391 actually listed their present occupation as engineer.

Engineers formed the largest single industrial grouping of technically trained graduates, but were only a small 25% of the total who studied science or engineering.

Engineers have chosen careers in editing, sales, education, medicine, law, and politics. There are clergymen and missionaries among Carnegie alumni, ambassadors and admirals, and even one Secretary of Defense. Three hundred and twenty nine Carnegie graduates are corporation or company presidents, 357 vice presidents, and 349 general managers.

It all poses a problem that has been commented upon to some degree in recent months. One speaker, F. J. Curtis of Monsanto, essentially summed-up the situation at an A.I.Ch.E. local section meeting: it is conceded that the use of trained engineers and scientists in non-engineering areas has been a boon to the growth and well-being of our industry, but the question remains as to whether or not we can continue to lose these men from technology at this time.

---

**The Eleventh National TAPPI Plastics-Paper Conference will be held on October 3-4** at the Institute of Paper Chemistry, Appleton, Wisc. The two-day program will consist of papers discussing new synthetic polymers and testing procedures for paper coating, saturation and beater addition. □

**Papers for the Twelfth Annual Conference of the Reinforced Plastics Division of the Society of the Plastics Industry must be in the SPI office by November 1, 1956.** Meeting will take place in February, 1957, at the Edgewater Beach Hotel in Chicago. Topics will be: in management subjects—foreign sales, cost estimating and control, safety and industrial hygiene, personnel training and development, and research and development; in technical subjects—engineering, premix, prepreg, mold makers, plastics for tooling, materials, preform, industrial design, and finishing. □

**The second annual titanium lecture program designed especially for practicing engineers will be conducted at the New York University College of Engineering from September 10-14.** The roster of speakers from industry, research labs, and the NYU faculty will include two leading British authorities on titanium, A. D. McQuillan of the University of Birmingham, and his wife, Marian McQuillan, of ICI. Subjects to be covered are: extraction and melting, phase diagram metallography and alloying, heat treatment and mechanical properties, mechanical metallurgy and applications, fabrication. □

**"Molecular engineering is the mode of thinking about engineering problems 'from the inside' by discerning the elementary particles and their interplay in gases, liquids and solids."** So says A. R. von Hippel, who will direct a special two-week summer program at MIT on Molecular Engineering August 20-31. The development and practice of molecular engineering requires a true alliance between engineers and scientists and the program is designed to "clarify outstanding issues by precipitating a vigorous clash of opinions in round-table conferences."

**A two-week intensive course on Nuclear Reactors and Radiations in Industry will be given by the Univ. of Michigan at Ann Arbor, August 21 to 31.** The course is intended for the engineer without previous experience in nuclear technology who wishes to acquire knowledge of representative problems and techniques in this rapidly developing field. □

**An Engineering Standards Committee has been formed by the Ultrasonic Manufacturer's Association.** Composed of members from 17 leading ultrasonic manufacturers in the United States, this committee has been established to formulate engineering standards and practices for this new and rapidly growing industry. □

## INSTITUTIONAL NEWS

**A week-long meeting, September 10-14, will climax the observance of the Perkin Centennial.** Sponsored by the American Association of Textile Chemists and Colorists, with the participation of 27 technical, chemical and scientific societies and 2 U. S. Government Depts., the meeting will be held in the Waldorf-Astoria Hotel in New York, will be highlighted by the presentation of over sixty papers by some of the world's leading authorities on various aspects of the field of dyes and colors. On Friday evening the Perkin Medal Award banquet will be held with Edgar C. Britton of Dow Chemical receiving the medal. □

**Information gathering for the 1956-57 volume of *Chemical Engineering Faculties* is well underway.** Questionnaires have been sent to all Chemical Engineering schools in the United States and Canada asking for a list of their faculty members in Chemical Engineering, the number of degrees granted in Chemical Engineering during 1955-56, and many other pertinent details concerning each school. The book, which will be out late in October, will be more useful than ever this year. □

**A pilot plant machine capable of coating paper by any of the present methods has been presented to the Univ. of Maine by Hercules Powder Co.** The machine, valued at replacement cost of $40,000, makes the Univ. of Maine one of the few institutions in the country completely equipped with modern facilities for research on paper coating problems. □

**The American Association of Cost Engineers was organized on June 2 at a meeting at the Univ. of New Hampshire.** Primary objective of the AACE will be the advancement of the science and art of cost engineering in or related to the process industries. The new group defined cost engineering as "the application of scientific principles and techniques to problems of cost estimation, cost control and profitability."

First president is Norman G. Bach, Monsanto. Vice president is J. W. Hackney, Diamond Alkali; secretary is J. T. Husted, American Potash & Chemical; treasurer is B. R. Landis, C. W. Nofsinger Co. Elected to serve as directors were: G. D. Carameros, El Paso Natural Gas Co.; C. A. Miller, Canadian Industries Ltd.; C. H. Chilton, McGraw-Hill; Irvine Lavine, Industrial Research Service; and O. T. Zimmerman, Univ. of New Hampshire.

# CANDIDATES FOR MEMBERSHIP IN A. I. Ch. E.

The following is a list of candidates for the designated grades of membership in A.I.Ch.E. recommended for election by the Committee on Admissions.

These names are listed in accordance with Article III, Section 8 of the Constitution of A.I.Ch.E.

Objections to the election of any of these candidates from Members and Associate Members will receive careful consideration if received before September 15, 1956, at the office of the Secretary, A.I.Ch.E., 25 West 45th Street, New York 36, N. Y.

## Member

Adams, James O., *Freeport, Tex.*
Anderer, Joseph H., *Springfield, Del. Co., Pa.*
Awde, Jack E., *Neshanic, N. J.*
Bagby, John R., *Texas City, Tex.*
Baird, Hugh A., *Alhambra, Calif.*
Bagan, Robert T., *Springfield, Mass.*
Branner, Frank M., *So. Charleston, W. Va.*
Corn, John W., *Charleston, W. Va.*
Cramer, Jack H., *Hopewell, Va.*
Davis, Milton W., Jr., *Aiken, S. C.*
Drobile, James Albert, *Philadelphia, Pa.*
Dye, Robert F., *Bartlesville, Okla.*
Eddy, Preston P., *Richland, Wash.*
Eickmeyer, A. G., *Kansas City, Mo.*
Farrell, Walter J., Jr., *Stamford, Conn.*
Finger, Joseph S., *Houston, Tex.*
Frye, Lee E., *Wilmington, Del.*
Glazier, Edwin M., *Pittsburgh, Pa.*
Hogeboom, R. W., *Kansas City, Mo.*
Holland, William D., *New York, N. Y.*
Kallal, Robert J., *Orange, Tex.*
Katz, J. Leonard, *New York, N. Y.*
Kleinert, Carl J., *Pottstown, Pa.*
Kling, Harold E., *Redondo Beach, Calif.*
Lannan, John A., *Byram, Conn.*
Le Sieur, H. A., Jr., *Honolulu, Hawaii*
McCondichie, D. H., *Westfield, N. J.*
Nelson, Clarence M., *Naugatuck, Conn.*
Neu, Ernest L., *Walteria, Calif.*
Nielsen, William W., *Texas City, Tex.*
Nowlin, R. L., *Modesto, Calif.*
Peterson, D. A., *Baton Rouge, La.*
Power, Arthur J., *So. Charleston, W. Va.*
Putney, David H., *Kansas City, Mo.*
Read, Walter F., *New York, N. Y.*
Roman, Louis J., *Memphis, Tenn.*
Romano, Giuliano, *Florham Park, N. J.*
Sanabor, Louis J., *Pittsburgh, Pa.*
Thompson, K. M., *Aldan, Del. Co., Pa.*
Tracy, Richard L., *Westfield, N. J.*
Webre, Albred L., Jr., *Napoleonville, La.*
Willard, Harry L., *Pittsburgh, Pa.*
Wingerd, Daniel H., *Wilmington, Del.*

## Associate Member

Adams, Clark W., *Kansas City, Mo.*
Aia, Michael A., *East Boston, Mass.*
Albanese, Paul F., *Westbury, N. Y.*
Althouse, Glenn F., *Bucyrus, Ohio*
Amberg, Stanley L., *Philadelphia, Pa.*
Ashcraft, William C., *Texas City, Tex.*
Backhaus, Edward, *Davenport, Iowa*
Baldechwieler, John D., *Cranford, N. J.*
Belove, Jack, *Brooklyn, N. Y.*
Bergstresser, Mack E., *Noble, Okla.*
Bernero, Louis, *Brooklyn, N. Y.*
Berzins, John P., *Indianapolis, Ind.*
Blake, G. Neil, *Circleville, Ohio*
Blinckmann, Robert A., *Glendale, N. Y.*
Bocchiaro, Joseph, Jr., *Jamaica, N. Y.*
Brant, George E., Jr., *Holly Hill, S. C.*
Brink, Robert R., *San Jose, Calif.*
Brown, Thomas P., *New York, N. Y.*
Butler, Richard E., *Prospect, Conn.*
Byrnes, W. Richard, *Sudbury, Mass.*
Cammarn, John W., *Columbus, Ohio*
Campbell, John J., Jr., *Bound Brook, N. J.*
Campbell, Robert B., *Kittanning, Pa.*
Canada, Ellwood B., Jr., *So. Charleston, W. Va.*
Carson, John B., *West Columbia, S. C.*
Cebula, Francis J., *Marcus Hook, Pa.*
Clarke, John M., *Charleston, S. C.*
Cody, Robert A., *Malinta, Ohio*
Coe, William David, *Jeffersonville, Ohio*
Cohen, Joseph D., *West Hempstead, N. Y.*
Colcolough, John J., Jr., *Columbia, S. C.*
Coman, J. Michael, *Tulsa, Okla.*
Cottington, Gregory I., *Ayrshire, Iowa*
Danziger, Leonard, *Brooklyn, N. Y.*
Decker, Dwight F., *Cleveland, Ohio*
DeHart, Patrick H., Jr., *Baton Rouge, La.*
DeKany, John P., *Long Island City, N. Y.*
Dell'Amore, John C., *Brooklyn, N. Y.*
DeWitt, William D., *Franklinville, N. Y.*
Dougherty, George L., *New Brunswick, N. J.*
Doyle, Richard David, *Ardmore, Pa.*
Dunn, Willard F., *Pensacola, Fla.*

*(Continued on page 72)*

# New Ray Stoppers

## National Lead reports recent developments in Lead shielding

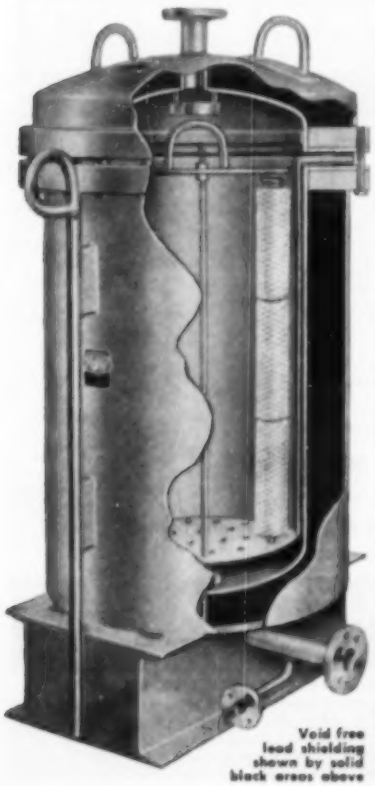
### *Improved casting process permits void-free shielding of heavy water filters*

**Internals only, need disposal in versatile "*Fulflo*" unit**

Until very recently, separate shields of rolled or extruded lead were considered standard for vessels processing "hot" fluids. It was assumed that only with this type of construction was porosity prevented and positive protection assured.

Now, however, integral steel jackets, lead-filled by an improved void-free National Lead casting process, may take over. Poured lead shielding, formed by this method, absorbs radiation as effectively as rolled or extruded lead. What's more, less lead is needed than with separate shields. Installation is less expensive, equipment more mobile.

Practicality of design and method were demonstrated by 18 *Fulflo* Filters, installed in a government plant, which were designed and built by Commercial Filters Corporation, Melrose, Massachusetts with void-free lead shielding poured by National Lead. These units (see cutaway view) filter 200 gpm of heavy-water-rich fluid. The integrated shields permit shells to be decontaminated and re-used indefinitely. Only the internals need periodic disposal. Shielding efficiency is said to be very high.

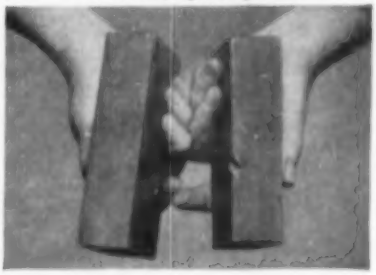


Void free lead shielding shown by solid black areas above

**Slave-handled drawers for radium equipped with novel lifting hook**

These new drawers for hospital radium safes are designed for slave manipulation. Drawer has two mating stainless-clad lead sections that slide apart. Upper section contains a recessed lifting hook. Produced by National Lead.

Hi-Hard brick *(left)* dents ordinary brick *(right)*



**National Lead now producing "Hi-Hard" lead brick**

Extruded lead brick with a Brinell hardness of 19 minimum are being produced by National Lead. Ordinary lead, with a density of 11.35, runs around 4 to 5 Brinell. Density of new "Hi-Hard" lead brick is 11.14. Thus there is a gain of better than 400% in hardness while retaining 98.2% density of ordinary lead. What this means to hot labs and other users of moveable lead shielding is obvious—fewer brick scrapped because of nicks and round corners, tighter walls, lower over-all costs for shielding.

**Low activity lead for sensitive counting now available from National Lead**

For applications where even the normally low emission of lead (generally from Pb-210) is objectionable in accurate, sensitive counting, unusually low activity lead is now available. If you have use for this "aged" lead, write nearest Company office listed below.

## National Lead Shielding

NATIONAL LEAD COMPANY: New York 6; Atlanta; Baltimore 3; Buffalo (Depew P.O.); Chicago 80; Cincinnati 3; Cleveland 13; Dallas 2; Philadelphia 25; Pittsburgh 12; St. Louis 1; Boston 6 (National Lead Co. of Mass.); Los Angeles 23 (Morris P. Kirk & Son, Inc.); Toronto, Canada (Canada Metal Company, Ltd.).

## CANDIDATES

*(Continued from page 70)*

Easterling, W. Lee, *Columbia, S. C.*
Fallo, Peter, *Glen Cove, N. Y.*
Faringer, Norris E., *Yakima, Wash.*
Feingold, David A., *Flushing, N. Y.*
Fisher, Joseph T., *Cleveland, Ohio*
Fishkin, Edward, *New York, N. Y.*
Forsythe, Mark E., *Lancaster, Ohio*
Freedberg, Arthur, *Worcester, Mass.*
Galer, Richard E, *Inkster, Mich.*
Gidaspow, Dimitri, *Brooklyn, N. Y.*
Gleason, Edward J., *So. Amboy, N. J.*
Gluck, Peter, *New York, N. Y.*
Golden, Charles E., *Columbus, Ohio*
Goodchild, Irwin L., *Jr., Amherst, Mass.*
Gortsas, Louis A., *Cincinnati, Ohio*
Gravlee, William Edward, *Spring Hill, Ala.*
Grembowitz, Frank, *Garfield, N. J.*
Gropler, Theodore A., *Maywood, N. J.*
Gruver, Morris E., *Jr., Rochester, N. Y.*
Gyaw, Hla, *Rangoon, Burma*
Haering, E. R., *Columbus, Ohio*
Harrell, Billy Wayne, *Fayetteville, Ark.*
Harris, W. Maxwell, *Jr., Oak Hill, W. Va.*
Hartman, Harold F., *Jr., Port Royal, Pa.*
Hazelton, James P., *Colorado Springs, Colo.*
Hendrick, Earl G., *Jr., Arlington, Va.*
Hermsen, Robert W., *Henderson, Nev.*
Hickson, James S., *Richmond, Va.*
Higgins, Paul J., *Staten Island, N. Y.*
Hippeli, Raymond Fred, *Brooklyn, N. Y.*
Hoffmann, Frederick E., *Maplewood, N. J.*
Holladay, Philip C., *Jr., Richmond, Va.*
Hornbeck, Parker, *Rome, N. Y.*
Howard, John C., *Hopewell, Va.*
Howland, Robert F., *Brooklyn, N. Y.*
Huebotter, Paul R., *Flint, Mich.*
Itkin, Ivan, *New York, N. Y.*
Jaeger, Joseph, *New York, N. Y.*
Jenus, Joseph, *Jr., Madison, N. J.*
Jicha, John James, *Jr., Staten Island, N. Y.*
Johnson, Daniel W., *Baytown, Tex.*
Johnson, William Arthur, *Worcester, Mass.*
Joks, Alfred, *Long Island City, N. Y.*
Jolley, Gordon B., *Gaffney, S. C.*
Jordan, Lawrence William, *Jr., Columbus, Ohio*
Kartel, Jack, *Mason City, Iowa*
Katz, Sheldon, *So. Euclid, Ohio*
Kaupas, Philip Francis, *Woodhaven, N. Y.*
Kihlstrom, Robert O., *Ashtabula, Ohio*
Klein, Henry J., *Uniondale, L. I., N. Y.*
Kleinberg, Sidney, *New York, N. Y.*

## CANDIDATES

*(Continued)*

Koch, Robert W., *Pittsburgh, Pa.*
Kohler, Conrad D., *Kohler, Wis.*
Kohlmeyer, Ronald, *New Hyde Park, N. Y.*
Kraft, Peter H., *New York, N. Y.*
Kulik, William A., *Brooklyn, N. Y.*
Lacho, Kenneth J., *Affton, Mo.*
Lamson-Scribner, Denis, *Palatine, Ill.*
Landis, Benjamin Mark, *Scotia, N. Y.*
Lekon, Alex, *Willoughby, Ohio*
Lerner, Martin, *Brooklyn, N. Y.*
Lewis, Gerald P., *Brooklyn, N. Y.*
Linder, Paul C., *Columbus, Ohio*
Ling, T. David, *Metuchen, N. J.*
Logan, L. Reynolds, *Bishopville, S. C.*
MacDonald, Robert J., *Arlington, Mass.*
Magnusson, Jon R., *Reykjavik, Iceland*
Marr, George, *Pittston, Pa.*
Marshall, Charles G., *Columbus, Ohio*
Martel, Eugene H., *Pascoag, R. I.*
Mazzella, Gerald, *Brooklyn, N. Y.*
McCoy, Charles Jerome, *Columbia, Tenn.*
McGrath, Douglas, *Brockport, N. Y.*
Meenaghan, George F., *Clemson, S. C.*
Mendell, Donald Pratt, *Saratoga Springs, N. Y.*
Messing, Guy G., *Downey, Calif.*
Miller, Barney, *Brooklyn, N. Y.*
Miller, Jerome B., *Elizabeth, N. J.*
Miller, Jimmie H., *Glasgow, Ky.*
Miller, Robert M., *New York, N. Y.*
Moll, Godfrey J., *New Providence, N. J.*
Mooneyhan, W. Ray, *Lynchburg, S. C.*
Moore, Eugene R., *Saginaw, Mich.*
Muller, Albert R., *Bayside, N. Y.*
Munley, William J., Jr., *Rocky River, Ohio*
Muren, Albert, Jr., *Barberton, Ohio*
Neville, Thomas R., Jr., *Schenectady, N. Y.*
Nitti, Donald A., *Brooklyn, N. Y.*
Nordgren, Eric A., *Brooklyn, N. Y.*
Oldenkamp, Richard D., *Conrad, Mont.*
Oney, William E., Jr., *Portsmouth, Va.*
Orgen, Donald, *New York, N. Y.*
Parsont, Robert Edward, *Merrick, N. Y.*
Penzias, Gunter Jim, *New York, N. Y.*
Petherbridge, David F., *Hallowell, Me.*
Phillips, Bruce D., *Scarsdale, N. Y.*
Pindzola, Daniel, *Brooklyn, N. Y.*
Primeau, Earl A., Jr., *St. Louis, Mo.*
Propst, Marshall E., Jr., *Hattiesburg, Miss.*
Ramachandran, S., *Adyar, Madras, So. India*
Reiff, Richard H., *Philadelphia, Pa.*
Ring, Donald D., *Cleveland, Ohio*
Roane, Russell T., *New York, N. Y.*
Roberts, Bob L., *Philadelphia, Pa.*
Rodriguez, Gilberto, *Bogota, Colombia*
Rodriguez, Harold J., *Jersey City, N. J.*
Romano, Anthony, *Forest Hills, N. Y.*
Roy, James V., Jr., *Plainfield, N. J.*
Salvesen, Clifford G., *Staten Island, N. Y.*
Saxena, K. B. L., *Portland, Mich.*
Scalise, Robert L., *Beckley, W. Va.*
Scallorn, Dean, *Cleburne, Tex.*
Schenk, Stuart L., *New York, N. Y.*
Schrager, Jerome S., *Brooklyn, N. Y.*
Schroder, Frank, *Bellevue, Mich.*
Schwab, Credo, *Tampa, Fla.*
Scott, Douglas A., *Western Springs, Ill.*
Sheely, Karl, *Columbia, S. C.*
Silliman, Henry H., Jr., *Montchanin, Del.*
Silverberg, Alvin, *Brooklyn, N. Y.*
Sindler, Allan J., *Camden, S. C.*
Smith, Archibald, Jr., *Clifton, N. J.*
Smith, Lawrence H., *Cornwall, N. Y.*
Sokol, Robert John, *Blairstown, Iowa*
Sotnick, Melvyn, *Brooklyn, N. Y.*
Srail, Raymond C., *Cleveland, Ohio*
Stecca, Eugene A., *Cleveland, Ohio*
Stein, Charles A., *Teaneck, N. J.*
Story, Richard Neil, *Columbus, Ohio*
Taylor, William A., *Alton, Ill.*
Thomann, Robert, Jr., *Clifton, N. J.*
Thomas, William R., Jr., *Red Bank, N. J.*

*(Continued on page 79)*

## FUTURE MEETINGS and Symposia of the Institute

Air view of Pittsburgh's "Golden Triangle."

**MEETINGS** **SYMPOSIA**

■ **PITTSBURGH, PA.**
Sept. 9-12, 1956. Wm. Penn Hotel.
See pages 56 & 57 of this issue for final roundup of features and pictures of those presenting papers.

Symposia scheduled include the following: Mixing, Distillation Computation Methods, Scientific Aids to Management (Operations Research), Explosions in Chemical Engineering, and Unit Operations in Nuclear Engineering. See July issue of C.E.P. (page 82) for complete meeting program.

■ **ANNUAL—BOSTON, MASS.**
Dec. 9-12, 1956. Hotel Statler.
TECHNICAL PROGRAM CHAIRMAN: W. C. Rousseau, Badger Mfg. Co., 230 Bent St., Cambridge 41, Mass.

**Filtration**
CHAIRMAN: F. M. Tiller, U. of Houston, Cullen Boulevard, Houston 4, Tex.
The flow of liquids through compressible media with experimental and theoretical papers.

**Low Temperature Techniques**
CHAIRMAN: Clyde McKinley, Air Products Inc., Allentown, Pa.
Papers dealing with gas prepurification for low-temperature processing and the low temperature aspects of heat exchange, refrigeration, distillation and liquid-vapor equilibria, and the properties of materials.

**The Sales Engineer in Chemical Engineering**
CHAIRMEN: W. E. Hesler, Swenson Evaporator Co., 30 Church St., New York City 7. E. D. Kane, Cuno Eng. Corp., S. Vine St., Meriden, Conn.
Three Panels: "Introducing Mr. Chemical Sales Engineer," "Training the Chemical Sales Engineer," "Performance Yardstick of the Chemical Sales Engineer."

**Laboratory Facilities for Nuclear Engineering Education**
CHAIRMAN: Joseph J. Martin, University of Mich., Dept. of Chem. & Metallurgical Eng., Ann Arbor, Mich.
Presentation of costs and uses of nuclear equipment in various educational curricula.

**Chemical Engineering Aspects of the Paper Industry**
CHAIRMAN: L. C. Jenness, U. of Maine, Orono, Me.

**Afternoon at the Ichthyologists**
General Session: "Obsolescence" of Chemical Engineers. Sunday P.M.: Round table discussion.

**MEETINGS** **SYMPOSIA**

**Advancing the Automatic Control of Chemical Process Plants**

CHAIRMAN: Wayne Alexander, Monsanto Chem. Co., Texas City, Tex. Co-chairman: David M. Boyd, Univ. Oil Products, Chicago, Ill. A C.E.P. round table session.

*Deadline—August 9, 1956*

■ **WHITE SULPHUR SPRINGS, W. VA.**

March 3-6, 1957. Greenbrier Hotel.

TECHNICAL PROGRAM CHAIRMAN: S. G. Friedman, E. I. duPont de Nemours & Co., Benger Lab., Waynesboro, Va.

**Computers in Chemical Company Control**

CHAIRMAN: W. M. Carlson, du Pont, Engineering Service Div., Newark, Delaware.

The use of large-scale computers in handling payrolls, billing and ordering, sales forecasting, production control, etc.

**Futures in the Chemical Industry**

CHAIRMAN: To be assigned.

■ **PHILADELPHIA, PA.**

March 10 through 16, 1957.

EJC Second Nuclear Engineering and Science Congress & Exposition. The Nuclear Engineering Division is sponsoring "The Fuel Cycle," & will participate in other general sessions. Send general papers to Prof. H. Ohlgren, Dept. Chem. Eng. & Met. Eng., U. of Mich., Ann Arbor, Mich.

Expected to be confined to subjects directly applicable to the overall nuclear fuel cycle. Fuel cycles for power plants and possible plants utilizing high temperature heat are envisioned.

■ **SEATTLE, WASH.**

June 9-12, 1957. Olympic Hotel.

**Industry's Role in University Programs on Nuclear Engineering**

CHAIRMAN: John Kaufmann, Div. of Reactor Development, U. S. Atomic Energy Commission, Wash., D. C.

■ **STATE COLLEGE, PA.**

August 11-14, 1957. Pennsylvania State University.

First National Conference on Heat Transfer, featuring Applied Heat Transfer. Sponsors: A.I.Ch.E., A.S.M.E., & College of Eng. & Arch., Penn State Univ.

■ **BALTIMORE, MD.**

September 15-18, 1957. Lord Baltimore Hotel.

■ **ANNUAL—CHICAGO, ILL.**

December 8-11, 1957. Conrad Hilton Hotel.

TECHNICAL PROGRAM CHAIRMAN; Henry F. Nolting, Standard Oil Co., 2400 New York Ave., Whiting, Ind. Asst. Chairman: A. L. Conn, Standard Oil Co., Box 431, Whiting, Ind.

**Fluidization of Solids**

CHAIRMAN: E. R. Gilliland, Chem. Eng. Dept., M.I.T., 77 Massachusetts Ave., Cambridge 39, Mass.

**Corrosion Resistant Alloy Materials of Construction**

CHAIRMAN: G. Fred Ours, Carbide and Carbon, Charleston, W. Va.

## UNSCHEDULED SYMPOSIA

Correspondence on proposed papers is invited.

**Laboratory and Pilot Plant Techniques**

CHAIRMAN: George W. Blum, Goodyear Tire & Rubber Co., Akron 16, Ohio.

*(Continued on page 78)*

# CEP CAMERA

**INDUSTRY SPONSORED SCHOOL**—Six professors attending Standard Oil of California's Annual University Faculty Seminar are shown visiting California Research Corporation (a Standard of California subsidiary). Left to right, E. B. Christiansen, prof. & head of Dept. of Chem. Engrg., University of Utah; E. B. Chiswell and J. Q. Cope (hosts), California Research; A. B. Scott, Oregon State; L. D. Pennington, Southern Oregon; G. J. Hunt, College of Idaho; Theodore Vermeulen, prof. of chem engrg., University of Calif. (Berkeley); A. R. Nichols, Jr., San Diego State; & V. A. Bolen, Eastern Oregon College. Scene shows group observing the forming of special vessels.

**OUR BUSY PRESIDENT—COALS TO NEWCASTLE**—Richard McDonald, awards chairman of the Washington Section (Seattle) carried West Coast's famed Dungeness crabs to home town of Ichthyologists (Boston Section) where they are being examined by A.I.Ch.E. president Walter G. Whitman (right).

**VAULT FOR THE FUTURE**—Chemical Engineers Club of Washington participates in George Washington University's project, with chemical engineering exhibits to be buried 100 years. Left to right, P. C. Groggins, H. Miller, B. R. Stanerson, J. Gillman, C. Moesel, F. Carman, J. Strobel, P. R. Hopper, D. Jenkins, C. R. Robertson, P. Davis, & Watson Davis.

**AT 2ND MEETING OF PRESIDENT'S COMMITTEE** for the Development of Scientists & Engineers—(above, left to right) Maynard Boring, representing A.S.E.E. (as its president), with T. H. Chilton, representing E. J. C. (as its president) standing in front of the Thomas A. Edison home, Menlo Park, N. J., scene of the meeting. At right, general view of the conference in one of Edison's rooms. Edison Foundation acted as host for this meeting.

## FUTURE MEETINGS

*(Continued from page 75)*

**MEETINGS** **SYMPOSIA**

**Centrifugation**

CHAIRMAN: James O. Maloney, Dept. of Chem. Eng., U. of Kansas, Lawrence, Kan.

The theory and quantitative aspects of centrifugation.

**Drying**

CHAIRMAN: Ralph E. Peck, Chem. Eng. Dept., Illinois Institute, 33rd Federal, Chicago 16, Ill.

**Direct Operating Labor Costs**

CHAIRMAN: John Happel, Chem. Eng. Dept., New York U., University Heights 53, N. Y.

**Size Reduction**

CHAIRMAN: Edgar L. Piret, Chem. Eng. Dept., U. of Minnesota, Minneapolis 14, Minn.

**Filtration & Centrifugation**

CHAIRMAN: Horace Hinds, Jr., Corn Products Refining Co., Box 345, Argo, Ill.

**Chemical Engineering Process Dynamics as They Affect Automatic Control**

CHAIRMAN: David M. Boyd, 315 Ridge Ave., Clarendon Hills, Ill.

**Ethylene Manufacture**

CHAIRMAN: Hermann C. Schutt, 201 Devonshire St., Boston 10, Mass.

**Dry Classification of Solids**

CHAIRMAN: D. W. Oakley, Metal & Thermit Corp., Carteret, N. J.

**Chemical Plant or Petroleum Process Plant Cost Estimates**

CHAIRMAN: C. W. Nofsinger, the C. W. Nofsinger Co., 906 Grand Ave., Kansas City 6, Mo.

**New Chemical Engineering Construction Techniques**

CHAIRMAN: S. A. Guerrieri, The Lummus Co., 385 Madison Ave., N. Y. 17.

**Mineral Process Engineering and Mineral Economics**

CHAIRMAN: L. A. Roe, International Minerals & Chemical Corp., 20 North Wacker Drive, Chicago 6, Ill.

**Chemical Engineering Education Abroad**

CHAIRMAN: S. A. Miller, Univ. of Kansas, Lawrence, Kansas.

### LOCAL SECTION MEETINGS

■ **NEW YORK**

October 18, 1956. Hotel Statler.

1-day meeting. Morning: Petroleum in the Jet Age. Afternoon: Advances in Food & Pharmaceutical Industry. Also all-day panel discussion on Cost Estimation. Sponsored by New York Section, A.I.Ch.E.

■ **CHICAGO, ILLINOS**

November 7, 1956. Conrad Hilton Hotel.

1-day meeting. Morning: The Pros and Cons of Unionism for Engineers. Afternoon: What Management Expects of the Engineer. Sponsored by the Chicago Section, A.I.Ch.E.

Gen. Arrangements chairman: Hal M. Hart, Standard Oil Company, P. O. Box 431, Whiting, Indiana.

## OVERSEAS NEWS

**Erection of an extraction plant in the heart of Africa will have an important effect on American insecticide production.** The plant, to be built at Goma in the Belgian Congo, will reduce pyrethrum flowers to the basic pyrethrins instead of shipping the flowers as heretofore. Since America takes a very large part of the pyrethrum production and extracts the flowers here, the new plant is expected to step-up American use by shipping only the extract.

This is the second such development in recent months, the other coming in British East Africa pyrethrum production. □

**An agreement to establish facilities for the manufacture of cellulose acetate yarns and fibers in Japan has been made between Mitsubishi Rayon Co., Ltd., and Celatino S.A., a wholly owned subsidiary of Celanese Corp.** Initial capacity will be 6 million pounds/year, Celatino will provide processes and know-how. □

**Nearly half the $3 million investment in a new chlorine-caustic soda plant in Israel came from American Electrochemical Industries, Inc. of Cleveland.** Using American and European know-how and equipment, the new plant, already on stream, will produce 2,700 tons of chlorine and 3,000 tons of caustic soda per year. □

## CANDIDATES

(*Continued from page 73*)

**Toepp, Burton E., II, South Bend, Ind.**
**Twiss, Albert H., Little Rock, Ark.**
**Uibo, Ansis E., East Orange, N. J.**
**Umphlett, Archie W., Jr., Columbia, S. C.**
**Vail, George, Lyndhurst, N. J.**
**Van Vliet, Hazen, Roseville, Mich.**
**Vollbrecht, Ralph E., Erie, Pa.**
**Wade, Lowell E., Port Arthur, Tex.**
**Wagner, Raymond J., Woodhaven, N. Y.**
**Wald, Emil W., Columbia, S. C.**
**Walker, Charles M., San Gabriel, Calif.**
**Walker, George E., Cleveland, Ohio**
**Walvick, Harold, Brooklyn, N. Y.**
**Wasyliw, Basil, Newark, N. J.**
**Wax, Richard, Brooklyn, N. Y.**
**Weary, S. Edward, Marion, Ohio**
**Whang, Ha Youn, Brooklyn, N. Y.**
**White, Francisco A., Cali, Colombia, S. America**
**Wolfe, R. Kenneth, St. Louis, Mo.**
**Woodworth, James A., Jr., Lake Jackson, Tex.**
**Wright, Eugene B., Jr., Clarksburg, W. Va.**
**Wysock, Merle M., Rocky River, Ohio**
**Yeoman, Neil, Queens, N. Y.**
**Zanzig, Charles E., Portage, Wis.**
**Zaybekian, Philip, Union, N. J.**

### Affiliate

**Ballester, Miguel A., Jr., Guayama, Puerto Rico**
**Boone, Ralph W., Midland, Mich.**
**Medve, Robert, Elizabeth, N. J.**
**Mills, Harold E., Fremont, Ind.**
**Morrissey, Donald J., Schenectady, N. Y.**

# Should Industry Encourage Technical Society Membership?

**Yes—says George L. Royer, administrative assistant to the General Manager of Cyanamid's Research Division.**

Industry should encourage its professional and scientific personnel to join and participate in professional and technical societies. Why? Here are the reasons George L. Royer presented at the Detroit national meeting of A.I.Ch.E.

•

**What helps the employee will in turn help the company.** Therefore, industry should encourage society membership from the simple point of self-interest if from no other.

Great emphasis is being placed on management development these days by industry. In the technical departments of a company there are **two areas of personnel development: administrative or supervisory, and professional or scientific.** Participation in a technical society can play an important part in both these areas.

**As a listener, the society member can enlarge his knowledge from the professional experience of others.** In his formal schooling listening has been his main source of information, and it is logical for him to attend lectures and listen to papers to enlarge his knowledge. During the informal discussions at technical meetings, he can participate in a conversational exchange of information which helps to challenge the creative mind. The experiences from listening at a technical society meeting are important in building up technical background for professional development. This knowledge, together with his own experiences, builds him up as a specialist and thus increases his value to the company as an expert in his field.

**In the technical part of any company, success, both for the individual and the company, depends on scientific knowledge and discoveries.** Industry realizes the importance of good scientists with creative minds, and these men should have the opportunity to grow professionally and not just administratively. Professional recognition and advancement is fully as important as managerial advancement.

**As a member of a technical society, the professional man can also gain information and experience on the leadership or administrative function,** both from lectures by those experienced in this area, and by 'doing' as a leader or officer in the society itself. As an officer he will be associating with personnel from various companies and from various supervisory levels, and he may have the opportunity of trying out ideas which could not be initiated within his own organization. Committee work in the professional society gives expression which can give individual satisfaction, and which in turn can be of overall and public relations value to the profession, to the company, and to the whole industry.

As a lecturer and author of the subsequent publication, **the professional man becomes known for his accomplishments outside his own company and starts to enlarge his scientific reputation.** This will have an effect on the scientific prestige of the company and be of significant public relations value.

Lecturing experience will help him in his own company to express his ideas and to sell them. The lecturer is also helping to put back into the world, with interest, information that he gained from others. Discussions as a result of these lectures may also lead to new creative thought which may, if tested and developed, lead to a financial return to the lecturer's company.

**Industry and the individual professional man both benefit from the technical society and both, therefore, should bear their share of responsibility and expense.** If an employee is permitted to go to a technical or professional meeting, it should be at company expense. Consideration should be given to the potential return to the company as well as to the individual. It would not seem reasonable for an employee to attend a technical meeting at company expense in a field in which the company has no present or future commercial plans. However, when it is obvious that the meeting will definitely benefit the company, attendance should be made a 'command performance' for the man who can best handle it.

**Technical societies can accomplish many things for industry and the profession which neither can do alone.** The future of the chemical industry and the profession depends upon a united effort in educating the public to science and its importance, and the relation of the chemical industry to other industries. This is a job in which the technical society can be pre-eminent. In the field of education there are many problems for which neither industry nor education separately have the answer. **Together, however, the problems can be solved and the technical societies are the common meeting ground.**

All industry can buy materials similar to their competitors, but **only by the proper development and use of their personnel can they be different or better than their competitors.** Industry, therefore, should encourage technical society membership to their own and their employees' professional advantage.

While industry can encourage men to participate in society activities, real participation can grow and develop only from the desires of the professional men themselves. **The society should be of great enough interest to the professional man that he wants to join and participate without the encouragement of industry.** A profession is a personal relationship, not something sponsored by an employer.

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**The industrial potentialities of the new heat resistant clothing, made by coating fabrics with a thin layer of aluminum, is emphasized by the Minnesota Mining & Manufacturing Co., developer of the process for coating the fabrics. In one demonstration, a suit of quilted glass fiber coated with aluminum withstood two to three minutes exposure at 1200° F.—with a man inside, of course.**

A.I.Ch.E. News of the Field
FROM LOCAL SECTIONS

## HEAR TALKS ON PLASTICS, POLLUTION, CORROSION, AND REFINING

Gamma irradiation of polyethylene in the presence of oxygen will produce chemical changes which permit further copolymerization with other monomers. B. Manowitz, Brookhaven National Labs, describing this fact to the April meeting of the **New York Section** (*A. B. Babcock, Jr.*), went on to point out that many polymers might be improved by such copolymerization either throughout the material or only on the surface. The New York meeting was a panel discussion, and R. W. Kupp, Vitro Corp., presented the chemical processing and reprocessing of uranium, while L. P. Hatch, Brookhaven, described the problems of radioactive waste disposal.

### Air Pollution and Research

Present thinking of scientists in the field of air pollution is that organic compounds and nitrogen oxides react in sunlight to form the irritating materials in "smog." Current theories point to the automobile exhaust as the principal culprit, rule out $SO_2$. With these facts, W. H. Claussen, Exec. Sec'y. of the American Petroleum Institute's Smoke and Fumes Comm., speaking to the April Meeting of the **Southern California Section** (*F. G. Sawyer*), went on to describe the work that brought about these conclusions, new techniques for measuring hydrocarbons in flue gas, and for tracing the path of gases after emission.

### A.I.Ch.E. and Corrosion

Describing the growth of A.I.Ch.E. from a 40-member organization in 1908 to its present size and importance, W. A. Cunningham, U. of Texas, emphasized to the **South Texas Section** (*G. Gibbs*) that the institute functions and receives its authority through the local sections. A major problem now being considered by the Institute's Council is the question of locating national headquarters in one building shared commonly by the other engineering societies.

The advent of the use of aluminum power transmission lines has created a severe corrosion problem at points where copper connections are made to the line. Speaking to the March meeting of the **Coastal Bend (Texas) Section** (*O. L. Culberson*), E. Korges, Texas A and I College, indicated that plastic and resin coatings have been found to be effective in controlling this

corrosion, but that they are expensive, with high waste resulting from a lack of suitable packaging. Mechanical coatings, on the other hand, are too short-lived.

**Refining**

Rapid strides in applications of hydrocarbon-conversion reactions to petroleum refining have overshadowed the steady but modest advances in separation and finishing. R. F. Marschner, pointing this out to the April meeting of the **Washington-Oregon Section** (*G. C. Szego*) held jointly with the Tacoma ACS section, showed that while early conversions like cracking and polymerization involved carbon-to-carbon bonds and increased the yield of gasoline, emphasis has shifted to conversions that involve carbon-to-hydrogen bonds and increase the octane number of gasoline. Catalytic reforming, which removes hydrogen from gasoline by converting naphthenes to arenes, is the most important of these. The hydrogen produced will likely promote the use of hydrogenation processes for improving petroleum products other than gasoline. Future advances in petroleum refining may well include application of new separations now in research stages.

**Also Meeting**

**Rochester Section** (*J. E. Millard*) made annual plant trip April 18 to Ontario Paper Co., Thorold, Ont. . . . **Baton Rouge Section** (*M. F. Gautreaux*) heard M. R. Fenske, Penn. State, describe the liquid ammonia extraction of petroleum compounds. . . . **Maryland Section** (*S. C. Streep*) plant trip and Ladies Night at the Gunther Brewery in Baltimore. . . . **Central Virginia** (*J. H. Rushton*) learned of Governmental Aspects of Trade Waste Disposal from H. L. Jacobs, Du Pont. . . . **Nashville Section** went on an April plant trip to Ferro Corp.'s Fiberglass plant.

**YOUR CHANGE OF ADDRESS**

National headquarters of A.I.Ch.E. is concerned about nondelivery of copies of *Chemical Engineering Progress* to members and subscribers. We therefore urgently request you to notify us promptly regarding your change of address. Allow 60 days for such change.

# people

**Walter H. Zinn** was presented with a special commendation by the U. S. Atomic Energy Commission "in recognition of his achievements as scientist and administrator in the A.E.C., beginning with his essential contributions to the world's first self sustaining chain reaction . . . and continuing during 10 years' service with distinction as Director of Argonne National Laboratory."

**John E. Myers,** associate professor of chemical engineering at Purdue U., appointed senior Fulbright lecturer in chemical engineering in the United Kingdom, 1956-1957. He will be at the University of Leeds.

**R. L. Langerhans,** associated with Linde Air Products and Union Carbide & Carbon since 1948, recently appointed to the development group on Linde's new molecular sieve adsorbents, Tonawanda, N. Y.

**Edward W. S. Nicholson** becomes assistant director of Esso Research and Engineering's process research division at Linden, N. J. He was formerly an executive in the research laboratories at Baton Rouge, La.

**Ernest T. Handley** appointed executive vice president of the Firestone Plastics Co., Pottstown, Pa.

**George A. Hawkins,** dean of engineering, Purdue U., is elevated to the rank of Fellow of the American Society of Mechanical Engineers.

Recently announced business manager for Food Machinery and Chemical Corp.'s central research laboratory, Princeton, N. J., is **S. Philip Marcus.** The laboratory will carry out long range research programs for the benefit of all six operating divisions of the firm.

**H. Barry Moyerman** becomes patent attorney for Atlas Powder Company's recently established license, patent and trademark department. He has been patent examiner in the U. S. Patent Office in Washington.

**Roy C. Harrison** joins the research and development division of the Phillips Petroleum Co., Bartlesville, Oklahoma. He had been technical director of the United Chemical Corp. of New Mexico.

**Henry C. Meiners,** manager of Union Oil Co.'s Los Angeles refinery since 1953, is appointed process consultant for Union's Brea Research Center.

Food Machinery and Chemical Corp., San Jose, Cal. makes **Carl F. Prutton,** left, executive vice president in charge of all chemical division operations. **John D. Fennebresque,** formerly vice president and assistant to the president, becomes executive vice president, located at the firm's headquarters in San Jose, Cal. Dr. Prutton has been a vice president and technical director since 1954. At the Becco Chemical Division of FMC, **Frederick A. Gilbert,** right, is elected president, succeeding **Max E. Bretschger,** who is retiring from the firm. With the firm for the past 21 years, Mr. Gilbert has recently been vice president and asst. division manager.

At Esso Research and Engineering, Linden, N. J., **Robert A. Louis, Eugene H. Okrent,** and **Walter C. Vliet** are new members of the staffs.

**William L. Everitt,** dean of the University of Illinois College of Engineering, is elected president of the American Society for Engineering Education.

Petroleum Chemicals, Inc., names **Bruce K. Brown** president. Although now president of Pan-American Southern Corp., he will transfer later in the year.

**Eugene J. Houdry** is named chairman of the board of Oxy-Catalyst, Inc.

Humble Oil & Refining Company announces staff additions at its Baytown, Texas, refinery: **Douglas C. Benton** to the research and development division and **Billy B. Ashby** to the technical service division.

**George E. Kimball,** pioneer in operations research, joins the staff of Arthur D. Little. One of the first members (later deputy director) of the Navy's Operations Research Group, Dr. Kimball is author, with P. M. Morse, of the basic text, "Methods of Operations Research."

**James F. Hall** becomes Pittsburgh Coke and Chemical's sales representative for industrial chemical sales in the Chicago area. For the past two years he has been a Pittsburgh sales representative for the plasticizer division.

**William Chalfant,** Atlantic Refining, Phila., is appointed assistant manager of the product control department. He is a former chairman of the Phila.-Wilm. Section of A.I.Ch.E.

**W. N. Williams** receives the 1956 Research Institute of America Award for Merit, in recognition of his firm's maintenance training program at the Newark, California plant. Mr. Williams is president of the Westvaco Mineral Products Div. of Food Machinery and Chemical Corp., N. Y.

**Harold E. Hoelscher** is named chairman of the chemical engineering department of Johns Hopkins U., where he has been an associate professor of chemical engineering.

**Harold Mazza** appointed to the newly-established position of manager, research, at American Potash & Chemical's Los Angeles plant. Since 1954, he has been asst. director of research at the Trona, Cal. plant.

**Ted M. Kersker** becomes manager of fabric development for all tire divisions of The Goodyear Tire & Rubber Co., Akron, Ohio. He was formerly chief textile engineer.

**Lawrence N. Canjar,** associate professor of chemical engineering at Carnegie Institute of Technology, awarded a $6,000 research grant from the National Science Foundation for research in the field of phase equilibria and thermodynamic data for mixtures.

**Seymour Baron** promoted to technical director of Burns & Roe's newly created chemical and nuclear section. He has been head of the firm's engineering specialist section.

**George J. Marlowe** is made director of project evaluation at Scientific Design Co. For the past six years he has been with American Cyanamid's organic chemicals division as supervising process engineer.

**Winford J. Janes,** of Hercules Powder Co.'s Franklin, Virginia plant, is appointed superintendent of tall oil distillation at Savannah plant.

Metal & Thermit announces three personnel changes in its staff: **Bernhard W. Weber** to manager of manufacturing operations, succeeding **Walton Smith,** who retires as vice president of manufacturing; and **Donald Oakley,** transferred from assistant production manager to technical advisor to the president.

ALCO Products appoints **Gilbert Fox** to supervise the company's fintube heat exchanger sales in the N. Y. area.

(*Continued on page 86*)

# people

*(Continued from page 85)*

Two of the highest honors in engineering education were awarded at the annual meeting of the A.S.E.E. to **L. M. K. Boelter,** dean of the College of Engineering, U.C.L.A., and to **Clifford Furnas,** on leave from the U. of Buffalo as asst. secretary of defense for R & D. Dr. Boelter received the Lamme Medal for contributions to engineering education, research, administration, and the advancement of the profession. Dr. Furnas received the Vincent Bendix Award for outstanding contributions in engineering college research and administration.

**A. Eugene Schubert** named manager of General Electric's chemical development department, Pittsfield, Mass. He was formerly manager of engineering for G.E.'s chemical materials department.

**E. Dorrance Kelly,** director of the government-owned synthetic rubber industry for three years, has joined the staff of the Synthetic Rubber and Latex Div. of Firestone Tire & Rubber Co.

**F. Albert Smiles,** director of technical service of Reichold Chemicals, Inc., named general manager of the firm's Elizabeth, N. J. plant.

**James Forrestal,** vice president and member of the Board, is appointed to the staff of the president of General Aniline & Film Corp. He will work in the Binghamton, Johnson City, Endicott and New York areas.

**H. D. McLeese** is elected a vice-president of Metal & Thermit Corp. and continues to direct sales, market development, research and advertising of the firm's products.

**Robert E. Lenz** to assistant director of the chemical research department in Monsanto Chemical Company's research & engineering division. Lenz, who has been special project manager for the division in St. Louis, will be headquartered at Dayton, Ohio where he will direct the engineering research section of the department.

**Grant E. Russell** is selected by his firm, Monsanto Chemical Co., to be among three technical men to undertake special graduate study courses in automatic process control during 1956-57 academic year. Mr. Russell will take a leave of absence to attend the U. of Minnesota.

**Bradley Dewey,** president and founder of Bradley Container Corp., Mass., announces his retirement from administrative duties with that company, and appointment as consultant to Olin Mathieson Chemical Corp.

**Monroe E. Spaght,** executive vice president and director of Shell Oil, N.Y., is the newly elected honorary chairman of American Section, Society of Chemical Industry, for the year 1956-1957. He is a director of Stanford Research Institute, American Petroleum Inst., the Institute of International Education, and is a trustee of Stanford U.

**John L. McPherson,** materials engineer with Blaw-Knox, Pittsburgh, is elected vice chairman of the Technical Practices Comm., National Association of Corrosion Engineers.

**Frank J. Soday** receives an honorary doctor of science degree from Grove City College., in recognition of his "contributions to chemical development in the South." Dr. Soday, a former student at the college, is vice president and director of R & D for the Chemstrand Corp., Decatur, Alabama.

**Ernest G. Enck** becomes director of planning of Foote Mineral Company, Phila. He retains his title of secretary of the firm and relinquishes his position as director of purchases.

**G. H. Law** is appointed vice president—research, and **H. M. West** becomes manager—textile fibers, at Carbide & Carbon Chemicals, New York. Dr. Law was director of research, and Mr. West was assistant to the vice president of Carbide & Carbon Chemicals.

**Thomas M. Clapham** joins Pittsburgh Coke & Chemical's engineering development section as a senior chemical engineer. He was formerly with American Oil.

At Aurora Gasoline, Detroit, **P. A. Blasco** assumes duties as general manager of refining operations. He was formerly assistant general manager.

**Sidney S. Prince,** recently of Chemical Construction Co., becomes associated with the U. S. Vitamin Corp. at their Yonkers N.Y. plant.

**A. E. New** is made director of the technical dept. of the manufacturing division, Escambia Bay Chemical, Pensacola, Florida. He has been director of process development at the Texas City plant of Carbide & Carbon Chemicals Co.

(*Continued on page* 88)

# people

(*Continued from page 87*)

**E. E. Litkenhous** named program director for engineering sciences on the staff of the National Science Foundation. He is on leave of absence from Vanderbilt U. where he has been head of the Ch.E. department since 1941, and executive director, division of industrial research, since 1953.

The appointment of four new members of the Advisory Committee of the Research Division, College of Engineering, is announced by New York U.: **Thomas H. Chilton,** technical director, development engineering division, of Du Pont, Newark, Delaware; **Werner W. Duecker,** manager, research department, Texas Gulf Sulphur Co., N.Y.; **Emil Ott,** vice pres. & dir., central chemical research, Food Machinery & Chemical, N.Y.; and **Roy H. Walters,** vice pres. & dir., research and development, General Foods, N.Y.

**John C. Hamilton** is made vice president, manufacturing, Canadian Resins and Chemicals Ltd., Montreal, Canada. He was previously general superintendent of plants.

At the chemical division's Mogadore, Ohio plant, General Tire & Rubber announces appointments of **Robert W. Laundrie** to chief process chemist in charge of process engineering and **Louis E. Gressingh** to process engineer.

**Herman L. Shulman,** professor of chemical engineering at Clarkson College of Technology, was awarded an honorable mention for the paper "Creativity and Engineering Education" at A.S.E.E.'s annual meeting.

**Robert W. Schramm** begins work with Union Carbide Development Co. on long-term corporate planning and evaluation of new business opportunities. He has been associated with Spencer Chemical Co., Kansas City, as coordinator of long range planning.

**Donald L. Elbert** becomes a member of the nylon spinning group of the development department of Chemstrand Corp., Decatur, Alabama.

**John Hegeman** is new production manager of Brown Company's kraft and sulphite mills, Berlin, N. H.

Shea Chemical Corp., Jeffersonville, Ind., announces the appointment of **William Waldeck** as technical director. His former position was director of research for Wyandotte Chemical Corp.

(*Continued on page 90*)

# people

(*Continued from page 88*)

**F. H. Catterson** is appointed general production manager of Ac'cent International, San Jose, California, a division of International Minerals & Chemicals Corp. He has been assistant general product on manager at the plant.

**Edward G. Fochtman** promoted to assistant supervisor of the fine particles section of the Armour Research Foundation, Illinois Institute of Technology.

**Philip M. Dinkins** elected a member of the Board of Directors of General Aniline & Film Corp., N. Y. He has been vice president, operations, dyestuff and chemical division, since joining General Aniline in 1955.

**Henry J. Bartels** is appointed job leader in the process study department of Hooker Electrochemicals Co., Niagara Falls, N. Y.

**Richard Steenrod** appointed materials engineer for the silicone products department of General Electric, Waterford, N. Y.



# the chemical engineer in

## MARKETING

**Milton D. Lange** joins the carbon black and pigment division of Columbian Carbon from Armstrong Tire & Rubber and is to take charge of the firm's new sales office in Monroe, Louisiana.

**Jack Maloney** appointed petroleum technical service adviser for the chemical division of Armour and Co., Chicago. **C. D. La Susa,** formerly petroleum specialist, becomes southern regional manager.

**D. Woodson Ramsey, Jr.,** coordinator of world-wide marketing operations of Standard Oil Co. (N.J.), is elected to the board of directors of Esso Research and Engineering Co. Beginning his career with the firm in 1928, he has served in the Caribbean, North African, Central European, and Latin American operations, and two years ago was advanced to deputy coordinator of marketing.

(*Continued on page 98*)

# Necrology

**James J. Jang,** 39, development engineer of The Fluor Corp., Ltd., Los Angeles, was killed on the TWA plane in the tragic mid-air collision June 30 over Grand Canyon, Arizona. Born in Canton, China, he came to the U. S. at the age of four and received his education here. Prior to joining Fluor he was associated with the Bechtel Corp. and Lee-Factors, Inc. on assignment to Dow Chemical Corp. He had been a senior development engineer since 1952 and recently worked on the development of a novel process for the recovery of copper scrap. Dr. Jang was a registered professional engineer in the states of California and Texas.

**L. D. Cook,** corrosion engineer, Bart Manufacturing Corp., was also killed in the mid-air accident over the Grand Canyon, while on the UAL DC-7. Formerly head materials engineer with Wyandotte Chemicals Corp., he was an acknowledged expert in the fields of corrosion and product contamination control. He had done extensive technical consulting on materials of construction for major chemical equipment used in production processes.

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- **heat transfer**
- **fluid flow**
- **catalysis**
- **gas kinetics**
- **thermodynamics**
- **pressure vessel design**

B.S., M.S., or Ph.D. graduates submit résumé covering education (approximate academic achievement), experience and work interests.

**LINDE AIR PRODUCTS COMPANY**
**A division of**
**Union Carbide and Carbon Corporation**

Att.: Mr. J. J. Rostosky P. O. Box 8237, Indianapolis 24, Indiana Refer to ad: CEP-A

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*What do you look for when you think of moving to a better position?*

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POSITIONS ARE AVAILABLE for physical and organic chemists with varying levels of academic training and experience. In addition there are openings for men with specific training in the reactor development field.

**It's your move. Be sure it's a good move. Call or write us before you make it. (Ask for our short, preliminary application card)**

*Robert L. Koller*

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INCORPORATED

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**Dr. F. C. Henriques, President and Technical Director; Dr. Marvin G. Scharr and Dr. Eric T. Clarke, Vice Presidents*

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*With 3 to 6 years' experience*

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Several qualified process engineers who wish to broaden their professional knowledge and responsibilities, will find such an opportunity in the Process Engineering Department of C F Braun & Co They will design a wide variety of plants for petroleum refining and large-volume petrochemical processing.

Engineering assignments range from complete integrated refineries and chemical plants thru all types of individual process units. The work includes heat and material balances, and computations for unit operations such as fractionation, heat-transfer, absorption and extraction.

Fine facilities, top salaries and many company benefits. Write to the head of our Personnel Department, Mr. F. B. Stratford.

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## CHEMICAL ENGINEERS

### Foreign Employment

For career assignments in technical service and research and development work in a large modern refinery installation in Saudi Arabia. Excellent opportunities for diversified experience and advancement assured by complexity of present installation and future expansion.

Liberal salary plus allowances and all-inclusive benefits. Opportunity to travel on long vacations and live in modern community with complete facilities including extensive recreation.

Write giving full particulars regarding personal history and work experience.

Please include telephone number.

Recruiting Supervisor, Box 175

**ARABIAN AMERICAN OIL COMPANY**

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**New York 22, New York**

## CHEMICAL ENGINEER

Technical advisory staff to the Manufacturing Division is in need of a man with chemical background to assist in coordination of quality control activities, preparation of official manufacturing procedures, work on special development studies and general statistical analysis. Recent graduate with chemical engineering degree or up to 3 years experience in applied statistics desired. Excellent opportunity for advancement. Call Personnel and Industrial Relations Department, FUlton 1-3000, to arrange interviews.

**METAL & THERMIT CORPORATION**
**Rahway, New Jersey**

## OPPORTUNITIES FOR PROCESS ENGINEERS

Young men with advanced degrees in Chemical Engineering or five years' experience in process design of oil refining facilities. Opportunities directly concerned with evaluation of research projects and design of new process units based on research and development in petroleum field. Write giving education, experience and personal history to Employment Supervisor.

**SHELL DEVELOPMENT CO.**
**Emeryville 8, California**

## CHEMICAL ENGINEERS

### Economic Evaluations

Engineering section of divisional research and development department has interesting and challenging opportunity for BS/MS Ch.E. with 8-14 years experience in economic evaluations and related fields such as production, process design and project engineering. Responsible for capital and production cost estimates, profitability calculations, and, with marketing section, for economic justification of R & D projects at various stages. Reports conclusions to top management.

Please send complete resume to:

Attention: A.G.D.
Research & Development Dept.
**Westvaco Chlor-Alkali Division**
Food Machinery and Chemical Corp.
South Charleston, W. Va.

## CHEMICAL ENGINEERS

Permanent positions of responsibility for engineers with five years' or more experience in chemical project engineering. Broad responsibilities in a rapidly expanding company which can give prompt recognition to progress and development.

Positions also available in production and engineering for recent graduates. Realistic starting salaries and other benefits. As a matter of policy this company underwrites and encourages membership and participation in Engineering Societies. Please submit complete résumé including history of earnings and salary requirements. Company literature and complete information about opportunities furnished upon request. Negotiations will be held in strict confidence.

Personnel Department
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## Shape your own future in POLYMERS

## GENERAL MANAGER

**MAJOR CHEMICAL FIRM** offers a fine position and excellent future for general manager of its new multi-million dollar polymer chemical plant in a pleasant Southern community.

**ESSENTIAL:**

Degree in chemistry, chemical or mechanical engineering. 15 years' operating experience in chemical industry. Thorough knowledge of organic chemical processes.

**DESIRABLE:**

Background in large-scale polymer manufacturing. Experience in production of close specification materials. Knowledge of modern managerial techniques.

This is an opportunity to establish yourself with a new project whose future is literally unlimited. Send complete resumé to Box 8-1.

## SITUATIONS WANTED

### A.I.Ch.E. Members

**DEVELOPMENT ADMINISTRATOR**—Financially oriented development supervisor with broad background in chemical development, age 32, B.Ch.E. Yale, combines return on investment with common sense development approach. Seeks to serve a growth company in a position placing high demands on technical ability, administrative talent and the faculty of dealing with people. Box 8-3.

**CHEMICAL ENGINEER**—B.Sc.Ch.E. 1942. Equal knowledge of German and English; Experience: nine years' research and development oil and gas processing, five years' process and job engineer for oil refineries. Desires European assignment as process, project or sales engineer. Box 8-4.

**TECHNICAL SALES**—B.S. in Ind. Adm. 1950. Graduate Studies Ch. Eng.—two years' multi-product chemical plant experience. Seeking challenging sales opportunity. Prefer East Coast. Age 27. Married. Veteran. Box 8-5.

**CHEMICAL ENGINEER**—B.S. 1950. Age 30, family. Six years' experience. Five years' in all phases of polyethylene manufacture. Presently employed, desire change, prefer Southwest. Box 8-6.

**CHEMICAL ENGINEER**—B.Ch.E. 1942. Age 36, married. Five years' experience manufacture of smokeless powder (production problems, production supervision, quality control time and motion studies, etc.). Desire to reenter technical work. Prefer West Coast. Box 8-7.

## CHEMICAL ENGINEERS

**0-5 years experience**

For development and process positions in our Chemical Research & Development Dept. which is located in a Chicago suburb. These positions offer an opportunity to utilize your education, ingenuity and develop the ability to handle engineering projects independently.

Engineers who are interested in design and construction work will find challenge and responsibility in our Central Engineering Dept. (Chicago loop).

Openings also exist in our Supervisory Development Program which lead to management positions in our manufacturing plants.

High starting salary adjusted for experience and training. Excellent working conditions and benefits. A progressive, growing company in a stable industry.

**Corn Products Refining Co.**

Send résumé, photo, and salary requirements to E. T. Harding, Box 345, Argo, Ill.

## INSTRUMENTATION ENGINEER

Our Engineering Research Group has an opening for an experienced engineer to organize a plant instrument department and direct instrument development and application.

This is an excellent opportunity for future responsibility in an expanding research and development department. Our company has shown constant growth and development for 65 years and offers opportunities with stability. Salary commensurate with qualifications. Complete benefit program.

If you are qualified and interested, write to R. C. Burrell, Technical Director

**THE RATH PACKING CO.**
Waterloo, Iowa

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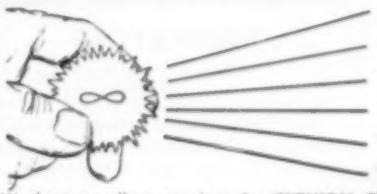

- DISTILLATION
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- PROCESS ENGINEERING
- THERMODYNAMICS
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We have excellent openings for **CHEMICAL ENGINEERS** in projects associated with the production and distribution of oxygen, nitrogen and argon as low temperature liquids or gases.

**LOCATION:** Our Tonawanda Laboratories in suburban Buffalo, New York—our largest research and development facilities.

B.S., M.S., Ph.D. graduates—send resume covering education (approximate academic achievement), experience and work interests to:

**LINDE AIR PRODUCTS COMPANY**
a division of **UNION CARBIDE AND CARBON CORPORATION** • Tonawanda, New York • Attention: Mr. P. I. Emch • P. O. Box 44, • Refer to ad: CEP-L

## CHEMICAL ENGINEERS

Excellent opportunities in rapidly expanding research and development department of medium sized chemical company. Work includes calculation, process design and operation of experimental equipment. Assignments will allow unusual opportunity for professional development and growth.

**Supervisory Engineers**

To manage section consisting of 10 to 15 chemical engineers and technicians. Advanced degrees are desirable, but not necessary. At least 6 years chemical engineering experience should include:

Design of experimental equipment
Shift operation of continuous flow Pilot Plant
Process design
Cost estimation
Scale up

**Process Development Engineers**

Chemical Engineers preferably under 30 with up to 3 years of pilot plant operation experience, economic evaluation, cost estimation, and flow sheet development. Knowledge of equipment design will be helpful, but is not required. Some shift work may be required.

**Process Design Engineer**

Chemical Engineer, under 30 with 3 to 5 years of process design experience, developing material and energy balances, flow sheets, instrumentation, and process equipment design for new processes. Will work in group on design of pilot plants, and eventual scale up to plant units.

These positions are in a Research Department located in Westchester County, New York among residential suburbs of New York City. Applicants should have good scholastic and professional aptitudes and possess a well balanced extra curricular and social background.

**STAUFFER CHEMICAL COMPANY**
380 Madison Avenue
New York 17, New York

Employee Relations Department

## TECHNICAL SALESMAN

An aggressive chemical Engineer, experienced in process design, is wanted to sell a complete line of specialty catalysts to the chemical and petroleum industries. Sales contacts will be made with research and development groups, process engineers, and operating personnel for consultation on process problems and the technical application of specialty catalysts.

This opening in a rapidly growing division of an internationally known company merits your investigation.

**THE GIRDLER COMPANY**

**Personnel Dept.**

**Box 987, Louisville, Kentucky**

### CLASSIFIED SECTION RATES

Advertisements in the Classified Section are payable in advance at 20¢ a word, with a minimum of four lines accepted. Box number counts as two words. Advertisements average about six words a line. Members of the American Institute of Chemical Engineers in good standing are allowed one six-line Situation Wanted insertion (about 36 words) free of charge a year. Members may enter more than one insertion at half rates. Prospective employers and employees in using the Classified Section agree that all communications will be acknowledged; the service is made available on that condition. Answers to advertisements should be addressed to the box number, Classified Section, Chemical Engineering Progress, 25 West 45th Street, New York 36, N. Y. Telephone COlumbus 5-7330. Advertisements for this section should be in the editorial offices the 15th of the month preceding publication.

## the chemical engineer in

## MARKETING

(*Continued from page 90*)

**Charles J. Harrington** assumes duties of assistant director of sales, elastomer division, for Du Pont, Wilmington. He has been assistant sales manager for isocyanates since 1954.

**Leon Breton** is appointed manager of market research and development for American Mineral Spirits, Chicago, Ill. He is responsible for the direction of market survey activities and consumer research in solvents, petroleum derivatives, and petrochemicals.

**Albert J. Gnesin,** field service engineer, in charge of Davison Chemical's new San Francisco office. He has been located in the Baltimore headquarters working on petroleum catalyst sales.

# INDEX OF ADVERTISERS



## C.E.P. Advertising Offices

*New York 36*—Lansing T. Dupree, Adv. Mgr.; John M. Goede, Asst. Adv. Mgr.; Paul A. Jolcuvar, Dist. Mgr.; Donald J. Stroop, Dist. Mgr.; Hale H. Carey, Dist. Mgr.; 25 W. 45th St., Columbus 5-7330.

*Chicago 11*—Richard R. Quinn, Dist. Mgr., 612 North Michigan Ave., Room 507, Superior 7-0385.

*Cleveland 15*—Eugene B. Pritchard, Dist. Mgr., 1836 Euclid Ave., Superior 1-3315.

*Pasadena 1*—Richard P. McKay, Dist. Mgr. 465 East Union St., Ryan 1-8779.

*Dallas 28*—Richard E. Haierman, 2831 El Capitan Drive, Davis 7-3630.

# news and notes of A.I.Ch.E.

**Career Guidance News Letter** has made its appearance . . . In turning out its first news letter, the Vocational Guidance Committee joins in an activity initiated by the Professional Development & Program committees . . . The new publication is edited by H. D. Guthrie & A. J. Lowery, Jr., . . . More & more A.I.Ch.E. committees are finding that information spread through a news letter helps to achieve their aims more quickly & easily . . . This is only one aspect of the **increased committee work being done** throughout the Institute . . . at the Pittsburgh Meeting twelve individual committee meetings have already been scheduled . . . Usually the Annual Meeting accommodates the one meeting a year customarily held by each committee, causing quite a jam for space & time . . . Spreading discussions through the year, however, keeps programs alive, and chairmen report more real progress.

**New Engineering Center:** The report on the location of a new engineering center, published in C.E.P. last month, has brought forth the following actions by the societies: the American Society of Mechanical Engineers, the American Society of Civil Engineers, & the American Institute of Mining, Metallurgical, & Petroleum Engineers have approved the recommendations in the report of the Special Task Committee; the American Institute of Electrical Engineers considered the report at a meeting on June 29, but deferred action until August. . . . The American Institute of Chemical Engineers, however, has more real problems than any of the other societies. . . . The story has been told to C.E.P. readers often, but it stands repeating . . . The original building now housing the four engineering societies was the gift of Andrew Carnegie . . . the land was purchased by the societies themselves. . . . Though the offer was made to four societies, the Civils did not accept the original Carnegie offer but waited until 1914, when they paid $266,000, & three additional floors were constructed to take care of their space needs. . . . A.I.Ch.E. never received any part of the Carnegie philanthropy . . . In the meantime the sinking fund & the value of the building & land have increased until each of the four societies has about $550,000 equity in the Thirty-ninth Street property . . . Since inclusion of these assets is contemplated in any new building program & since the Kelly group is going to raise funds in the name of the four societies now at Thirty-ninth Street & the A.I.Ch.E., some procedure must be worked out to include A.I.Ch.E. in the United Engineering Trustees, which is the corporation set up by the four societies to take care of their real estate problems . . . On top of that, it is the feeling of the Kelly group that A.I.Ch.E. should not approach industry for funds at the same time that the group is raising major contributions for the new engineering building . . . therefore any equity at all for A.I.Ch.E. in the U.E.T. building program must come either from funds subscribed by A.I.Ch.E. members or from a philanthropist or a group of philanthropists willing to drop a tidy sum of money in our laps . . . Any volunteers? . . . Paul Kite, Chairman of the Housing Committee, has been devoting considerable time to the housing problem, having had several conversations with Mervin J. Kelly, President of Bell Telephone Laboratories, Inc., who is chairman of the group which will raise the funds . . . It was Kelly's opinion that all the societies ought to conduct a campaign for individual contributions from the members . . . This is also the viewpoint of B. F. Dodge, who was chairman of the Special Task Committee that prepared the study. . . . A.I.Ch.E. Executive Committee will meet on August 20 to discuss all the problems facing A.I.Ch.E. & there will be a special Council meeting on September 8 in Pittsburgh at which a full day is expected to be devoted to the housing discussion alone.

**Alton-Wood River Section** has conducted an essay contest among the seniors of seven high schools on "What the Chemical Profession Offers Me as a Career" . . . The prize was won by James Massey of the Alton Senior High School . . . Last year the section was guided by D. W. Miller of Shell Oil Company & since June, 1956, has been under the leadership of A. C. Hershey of Standard Oil Company. **Membership Note:** Joe Koffolt, Chairman of the Chemical Engineering Department at Ohio State University, has continued the phenomenal record of past years in membership applications from his students . . . 100% of all the bachelors and the Ph.D.'s have applied for membership in the A.I.Ch.E. this year & 93% of the masters . . . Joe is still working on the holdouts and feels certain he will convince them shortly.

F.J.V.A.

# Brown Fintube

# *Thermo-Flo*

## TANK HEATERS

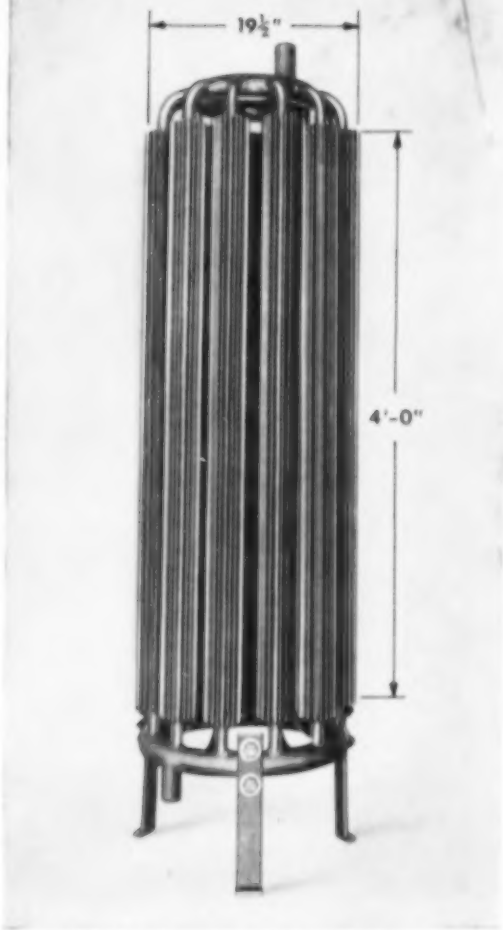
**Vertical mounting keeps the bottom of the tank uncluttered;** prevents sediment from settling on the heating surface; permits the heater to be entirely immersed in the product; and avoids the loss in efficiency of trying to heat from a coil insulated in sediment on the tank bottom.

The large surface area of the finned tubes permits more heat to be transferred at lower "skin" temperature. Product adjacent to the heater rises rapidly forming a thermal siphon in the tank, that assures efficient heating; prevents overheating; avoids stratification; and keeps the heating surface clean.

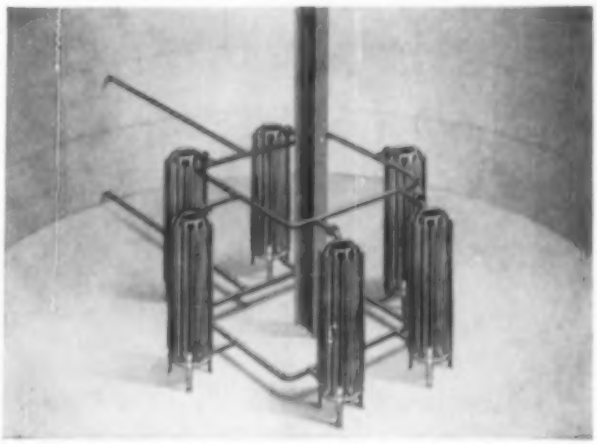
Mild steel, stainless or special metal construction. Can be stress relieved if desired. Easily installed in new tanks or tanks already in service. Used — and highly endorsed — by practically all large well-known companies maintaining tank farms.

*Bulletin No. 561 gives full details.*

**WRITE FOR A COPY TODAY!**




Above; View of Brown Fintube Thermo-Flo Tank Heater Showing the Legs that are Adjustable to Overcome any Unevenness of the Tank Bottom.



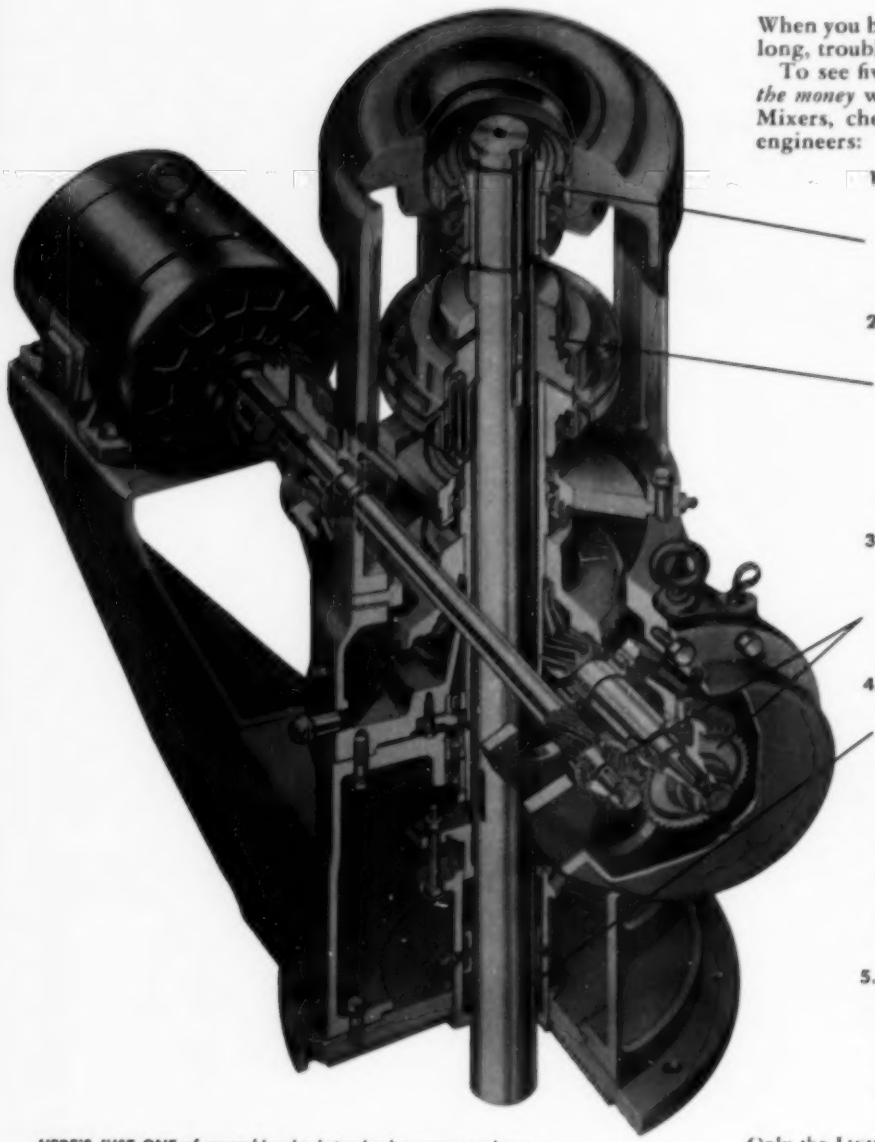
Six Thermo-Flo Tank Heaters Manifolded to a Single Steam Line in a Bunker C Storage Tank, Showing Bottom of the Tank Completely Open for Quick, Easy Cleaning.

# BROWN FINTUBE COMPANY

*Elyria, Ohio*

***Engineering and Sales Representatives in the Principal Cities***

# *Get these* **extra years** *of fluid mixing built into every Lightnin Mixer you buy*



**HERE'S JUST ONE** of several hundred standard power-speed combinations you can buy in Series "E" LIGHTNIN Mixers. This double reduction assembly provides up to 8 interchangeable mixing speeds, from 68 to 280 RPM. It converts easily to single or triple reduction for a total range of 16 standard speeds.

When you buy a mixer for fluids, you're banking on long, trouble-free service. Are you getting it?

To see five specific ways you get *more mixing for the money* when you specify turbine-type LIGHTNIN Mixers, check these practical questions asked by engineers:

1. **Can I remove and replace the mixer shaft easily?** Yes. You can remove a LIGHTNIN Mixer shaft upward or downward, easily and safely. This adapter-type fixed bearing assembly grips and centers the mixer shaft, realigning it accurately when you replace the shaft.

2. **What if the impeller accidentally whacks something in the tank? Are gears protected?** Gears are fully protected. This flexible coupling absorbs normal and abnormal shaft flexures. Coupling acts as a mechanical "fuse" between the mixer shaft and hollow drive quill. Mixer shaft is suspended on separate ball bearings independent of the speed reducer. The quill surrounds the shaft like a sleeve, but does not touch it. Shock loads on the shaft can never reach the gears.

3. **Can I change mixing speed later if process requires it?** Yes—provided the new speed doesn't increase mixing load beyond the mixer's rated capacity. These change gears permit quick, simple interchange of as many as 16 standard speeds, from 16.5 to 420 RPM.

4. **How can I cut cost of pressure or vacuum mixing?** Two ways. This easy-to-service stuffing box runs longer between packing changes, because it's integral with the mixer mounting flange—aligned *as a unit* with the shaft bearings for true, steady running.

   And now, you can end stuffing-box maintenance *for good*—with the easy-to-change LIGHTNIN rotary mechanical seal. The seal, not shown here, takes the place of a stuffing box. It stops leakage, runs for years without adjustment. Yet you can replace it *in minutes* if you ever need to—without dismantling the mixer, without need for special skills.

5. **Can I change this mixer from one tank to another without costly special construction?** Certainly. You can switch a LIGHTNIN from open-tank to closed-tank mounting, from top entering to bottom entering, and vice versa, and adapt it for low-headroom installation. You can make any of these changes using standard stock components.

Only the LIGHTNIN drive gives you flexibility like this, to keep your mixing costs low over the years.

And every LIGHTNIN Mixer you buy is guaranteed, unconditionally, to do the mixing job for which it is recommended.

Ask your LIGHTNIN representative (listed in Chemical Engineering Catalog) to explain how *you* can get extra years of fluid mixing, at low mixing cost. Or ask us by mail.

**FOR LATEST MIXING INFORMATION and full description of LIGHTNIN Mixers, send for these helpful bulletins:**

- ☐ B-102 Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP
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- ☐ B-108 Portable: ⅛ to 3 HP
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- ☐ B-112 Laboratory and small-batch production types
- ☐ B-109 Condensed catalog showing all types
- ☐ B-111 Quick-change rotary mechanical seals for pressure and vacuum mixing
- ☐ B-107 Data sheet for figuring mixer requirements

Check, clip, and mail with your name, title, company address to:

**MIXING EQUIPMENT Co., Inc., 199-h Mt. Read Blvd., Rochester 11, N. Y.**

*In Canada: Greey Mixing Equipment, Ltd., Toronto 10, Ont.*

"Lightnin" Mixers

**MIXCO fluid mixing specialists**